Direct Superficial Temporal Vein Approach for Dural Carotid Cavernous Fistula

S. MATSUBARA, K. KAZEKAWA, H. AIKAWA, M. ONIZUKA, M. TSUTSUMI, M. IKOU, T. KODAMA, K. NII, S. NAGATA, A. TANAKA

Department of Neurosurgery, Chikushi Hospital, Fukuoka University

Key words: dural AVF, cavernous sinus, superficial temporal vein, embolization

Summary

We present an alternative endovascular approach to treat dural carotid cavernous fistulae (dural CCF) that drain only into the superior ophthalmic vein. Four cases of cavernous dural AVFs that could not be treated via the inferior petrosal vein were accessed via the direct superficial temporal vein approach through the superior ophthalmic vein. Successful embolization was documented radiographically and clinically in all patients. The trans-superficial temporal vein approach is safe and useful for inaccessible dural CCFs through the inferior petrosal sinus.

Introduction

Transvenous embolization with coils are now considered to be the first treatment option for dural CCFs. The inferior petrosal sinus is the usual access route to the cavernous sinus, but is sometimes inaccessible. Transvenous embolization of dural CCFs using the superior ophthalmic vein (either by surgical exposure or transcutaneous puncture) has been previously used safely and successfully in a limited number of selected cases. However, the superior ophthalmic vein approach has the potential complication of precipitating acute exophthalmos and subsequent visual loss. We present an alternative approach via the superficial temporal vein to treat dural CCFs that could not be treated using the inferior petrosal sinus.

Material and Methods

Patients

Four patients, 60 to 78 years old, with dural CCF were treated using the direct superficial temporal vein approach. The clinical characteristics are summarized in table 1. In all the patients, drainage from the cavernous sinus coursed primarily into the superior ophthalmic vein, periorbital vein, and superficial temporal vein.

Techniques

Under general anesthesia, the transfemoral venous approach was attempted via the bilateral inferior petrosal sinuses, but the microcatheter could not reach the fistula because of occlusion of both inferior petrosal sinuses or compartmentalization of the cavernous sinus. Therefore, in three patients, 1 cm of skin was incised and the superficial temporal vein was exposed under road mapping. Then a Renegade microcatheter (Boston Scientific, Natick, MA) was introduced into the vein by direct puncture.

In one patient (Case 1), an 18-G intravenous needle was inserted percutaneously in the markedly dilated right superficial temporal vein and a Renegade microcatheter was navigated into the superior ophthalmic vein. The microcatheter was placed in the cavernous sinus via the left superior ophthalmic vein. The sinus was packed with GDCs.

Figure 1 Case 2. A 67-year-old woman. A) Right common carotid angiogram (arterial phase), lateral view, showing a dural AVF of the cavernous sinus with venous drainage to the superior ophthalmic vein. B) Right common carotid angiogram (venous phase), lateral view, showing the markedly dilated superior ophthalmic vein (arrows) and superficial temporal vein (arrowheads). C) Schematic drawing revealing exposure of the superficial temporal vein. D) Right cavernous sinogram, lateral view, showing venous outflow to the superior ophthalmic vein and superficial temporal vein. E) Post-embolization angiogram, lateral view, showing the packing of GDCs in the cavernous sinus and complete occlusion of the dural AVF. F) Post-embolization angiogram, left anterior oblique view.

Case Report

Case 2

A 67-year-old woman presented with a two-month chemosis of the right eye. Angiography demonstrated a dural AVF of the cavernous sinus fed from the right internal carotid artery and the right external carotid artery (figure 1A). Drainage from the cavernous sinus coursed only into the right superior ophthalmic

vein, periorbital vein, and left superficial temporal vein (figure 1B). The patient was treated conservatively for three weeks, but her visual acuity of the right eye diminished. Ophthalmologic examination suggested right retinal ischemia secondary to the dural fistula.

Under general anesthesia, the transfemoral venous approach was attempted via the bilateral inferior petrosal sinuses, but the microcatheter could not reach the cavernous sinus because of occlusion of both inferior petrosal sinuses. Finally, 1 cm of skin was incised and the superficial temporal vein was exposed under road mapping (figure 1C). Then a Renegade microcatheter was introduced into the vein by direct puncture. The microcatheter was placed in the cavernous sinus via the right superior ophthalmic vein (figure 1D). The sinus was packed with GDCs, and the dural AVF was obliterated completely (figure 1E,F). Her symptoms resolved completely within two weeks.

Table 1 Summary of Patients Using Trans-STV Approach.

Case No.	Age/Sex	Duration of symptoms	Symptoms
1	72Y/F	26W	chemosis, diplopia, periorbital swelling
2	67Y/F	5W	chemosis, proptosis, decreased vision
3	60Y/M	6W	chemosis, orbital pain
4	78Y/M	16W	chemosis, decreased vision

Discussion

Dural CCFs present with ocular symptoms, such as exophthalmos, chemosis, proptosis, or

diplopia. Conservative treatment is usually recommended in patients with mild clinical symptoms because of the high probability of spontaneous occlusion¹. Aggressive treatment is indicated, however, in patients with deterioration of visual acuity, recruitment of cortical venous drainage, glaucoma, severe exophthalmos, or persistent ophthalmoplegia².

Transvenous endovascular treatment is currently standard therapy for dural CCFs^{3,4}. The

inferior petrosal sinus is usually used as the transvenous approach of choice because of safe, easy accessibility. In many patients with dural CCF, the cavernous sinus is accessible via the inferior petrosal sinus even in patients in whom the inferior petrosal sinus is not opacified by angiography. However, in some cases, the microcatheter can not reach the cavernous sinus. The inferior petrosal sinus has no connection with the internal jugular vein (7%) or ex-

ists as a plexus of veins (24%)⁵. The inferior petrosal sinus can also thrombose spontaneously. In addition, compartmentalization of the cavernous sinus results in failure of this approach⁶. Transvenous embolization of cavernous dural CCFs using the superior ophthalmic vein (either by surgical exposure or transcuteaneous puncture) has been previously used safely and successfully in a limited number of selected cases^{7,8}.

The superior ophthalmic vein approach has the potential complication of precipitating acute exophthalmos and subsequent visual loss^{9,10}. If the superior ophthalmic vein is injured, retroorbital hemorrhage can occur or venous drainage can be directed into intracranial pathways, increasing the risks of neurologic complications. Thus, this approach demands an experienced orbital surgeon. Although a successful approach via the superior ophthalmic vein through the facial vein has been reported¹¹, it seemed unlikely to succeed in our four cases, since the angular vein and facial vein were not dilated on angiograms. Venous drain-

nage from the cavernous sinus was directed into the superficial temporal vein through the superior ophthalmic vein.

If the transfacial vein approach and the trans-superficial temporal vein approach fail to reach the cavernous sinus, the direct superior ophthalmic vein approach is left. Therefore, we believe these approaches should be considered before attempting the direct superior ophthalmic vein approach, for safer endovascular treatment of the dural CCF which cannot be approached via the inferior petrosal sinus.

Conclusions

We describe four cases with dural CCF, in whom endovascular treatment was performed using the direct superficial temporal vein approach thorough the superior ophthalmic vein. This approach should be considered before attempting the direct superior ophthalmic vein approach, for safer treatment of dural CCFs which cannot be approached via the inferior petrosal sinus.

References

- 1 Viñuela F, Fox AJ et Al: Spontaneous carotid-cavernous fistulas: clinical, radiological, and therapeutic considerations. Experience with 20 cases. *J Neurosurg*, 60: 976-984, 1984.
- 2 Awad IA, Little JR, Akrawi WP, Ahl J: Intracranial dural arteriovenous malformations: factors predisposing to an aggressive neurological course. *J Neurosurg*, 72: 839-850, 1990.
- 3 Debrum GM: Angiographic workup of a carotid cavernous sinus fistula (CCF) or what information does the interventionalist need for treatment? *Surg Neurol*, 44: 75-79, 1995.
- 4 Halbach VV, Higashida RT et Al: Dural fistulas involving the cavernous sinus: results of treatment in 30 patients. *Radiology*, 163: 437-442, 1987.
- 5 Shiu PC, Hanafey WN et Al: Cavernous sinus venography. *Am J Roentgenol*, 104: 57-62, 1968.
- 6 Chaloupka JC, Goller D et Al: True anatomical compartmentalization of the cavernous sinus in a patient with bilateral cavernous dural arteriovenous fistula: case report. *J Neurosurg*, 79: 592-595, 1993.
- 7 Courtheoux P, Labbe D et Al: Treatment of bilateral spontaneous dural carotid-cavernous fistulas by coils and sclerotherapy. *J Neurosurg*, 66: 468-470, 1987.
- 8 Monsein LH, Debrun GM et Al: Treatment of dural carotid-cavernous fistulas via the superior ophthalmic vein. *Am J Neuroradiol*, 12: 435-439, 1991.
- 9 Devote MH, Egbert JE et Al: Acute exophthalmos during treatment of a cavernous sinus-dural fistula through the superior ophthalmic vein. *Arch Ophthalmol*, 115: 823-824, 1997.
- 10 Gupta M, Kikkawa DO et Al: Severe vision loss and neovascular glaucoma complicating superior ophthalmic vein approach to carotid-cavernous fistula. *Am J Ophthalmol*, 124: 853-855, 1997.
- 11 Mizuno T, Kai Y et Al: Treatment of spontaneous carotid-cavernous fistula by the transvenous approach via the facial and angular route. *No Sinkei Geka*, 29: 961-964, 2001.

Shuko Matsubara, M.D.
Department of Neurosurgery
Chikushi Hospital, Fukuoka University
1-1-1, Zokumyoin, Chikushino-shi
Fukuoka 818-8502, Japan
E-mail: shuko_mm@hotmail.com