A Case of Cavernous Sinus Dural Arteriovenous Fistula Treated by Transfacial Vein Placement of a Distal Access Catheter in the Cavernous Sinus

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Objective: The first choice for the treatment of cavernous sinus dural arteriovenous fistula (CSdAVF) is transvenous embolization. The inferior petrosal sinus (IPS) approach is commonly used, but modification of the procedure is necessary in patients with IPS occlusion. We treated one patient by guiding a distal access catheter (DAC) to the cavernous sinus by the transfacial vein approach through the superior ophthalmic vein and obtained a favorable outcome.

Case Presentation: A 68-year-old woman with CSdAVF presented with ophthalmic symptoms. All feeding arteries converged in a pouch on the superior aspect of the medial posterior segment, and the superior ophthalmic vein/facial vein was the only drainage route. A 3.4 Fr TACTICS used as a DAC in a triple coaxial system was placed in the cavernous sinus via the facial and superior ophthalmic veins, a micro-catheter was navigated to the shunted pouch, and CSdAVF was embolized with two coils.

Conclusion: 3.4 Fr TACTICS is useful as a DAC in the transfacial vein approach to CSdAVF through the superior ophthalmic vein.

Keywords: cavernous sinus dural arteriovenous fistula, transfacial vein approach through the superior ophthalmic vein, selective transvenous embolization, distal access catheter, TACTICS

Introduction

The first choice for radical treatment of cavernous sinus dural arteriovenous fistula (CSdAVF) is transvenous embolization.1) Recently, as detailed diagnosis of the shunt site has become possible due to the development of intracranial angiographic devices, selective embolization of the shunted pouch has become a feasible choice.2–4) Transvenous embolization is commonly performed by the transfemoral approach, and the lesion is approached primarily via the inferior petrosal sinus (IPS) because of the ease of access. In a case of CSdAVF with occlusion of the ipsilateral IPS, we guided a distal access catheter (DAC) into the cavernous sinus via the facial and superior ophthalmic veins using a triple coaxial system, succeeded in delivering a micro-catheter to the shunted pouch, and achieved cure by coil embolization of the shunted pouch alone.

Case Presentation

A 68-year-old woman suddenly developed conjunctival congestion, edema and exophthalmos of the left eye. She was suspected to have CSdAVF at the ophthalmology department based on MRI findings and was referred to our department. She had no history of trauma or surgery. She also had no particular familial history.

Cerebral angiography

The feeding arteries were the left accessory meningeal artery, left artery of foramen rotundum (Figs. 1a and 1b), left medial clival artery (Figs. 1c and 1d), and right medial
clival artery (Figs. 1e and 1f). They all converged on the superior aspect of the medial posterior part of the cavernous sinus, formed a shunted pouch, and drained into the posteromedial segment (Figs. 1g and 1h). The outflow tract was from the left superior ophthalmic vein (Lt. SOV) to the left internal jugular vein (Lt. IJV) via the left facial vein (Lt. FV). No other drainage route including the ipsilateral IPS was observed (Fig. 2).

**Endovascular treatment**

Endovascular treatment was performed under general anesthesia. A 5 Fr sheath was placed in the left femoral artery, and a 6 Fr long sheath was placed in the right femoral vein. Systemic heparinization was performed. For intraprocedural angiography, a 5 Fr OK2M 100 cm (Katecs, Osaka, Japan) was navigated to the left common carotid artery and placed for subsequent maneuvers. A 6 Fr ENVOY MPD 90 cm (Johnson & Johnson, Miami, FL, USA) was guided to the Lt.IJV using a 4 Fr OK2M 125 cm (KATECS) and a 0.035 inch guidewire. Via the 6 Fr ENVOY, a triple coaxial system consisting of a 3.4 Fr TACTICS 130 cm (Technocrat Corporation, Aichi, Japan), which was used as a DAC, an Excelsior SL-10 (Stryker, Kalamazoo, MI, USA), and a Tenrou1014 (Kaneka Medics, Osaka, Japan) was advanced to the cavernous sinus by guiding it retrogradely through the Lt. FV, left angular vein, and Lt. SOV (Figs. 3a–3e). The 3.4 Fr TACTICS could be easily guided through the angular vein and advanced into the cavernous sinus (Figs. 3d and 3e). Since the DAC reached the cavernous sinus, the manipulability of the micro-catheter and micro-guidewire in the cavernous sinus could be improved, permitting their free guidance to each segment. The micro-guidewire was changed to Chikai 14 (Asahi Intec, Aichi, Japan), placed along the wall of the posterior medial segment, which was the target, and the Excelsior SL10 could be navigated to the shunted pouch above this site (Fig. 3f). The shunt could be occluded by coil embolization of the shunted pouch alone (Fig. 4). Two coils, that
CSDAVF is treated by transfacial vein placement of a DAC

Moreover, insufficient sinus packing may cause change in the venous drainage route and reflux to cortical veins and result in postprocedural venous congestion and intracranial hemorrhage.6,7)

Selection of the approach
Transvenous embolization for CSDAVF is usually performed by inserting a catheter via the femoral vein. Particularly, the trans-IPS approach is selected as the first choice because of the ease of obtaining access and shortness of the access route. Even in patients in whom the IPS is not visualized, the cavernous sinus is reportedly reached often by guiding a micro-catheter after navigating a micro-guidewire through an estimated route of IPS.8) However, there is also a report that the venous sinus was perforated by the guidewire in advancing it through the occluded IPS,9) and careful selection of the approach is necessary. Various alternative access routes have been reported in case the trans-IPS approach is difficult to use. They include the facial vein,10–12)

Discussion
CSDAVF is detected primarily with the occurrence of symptoms, such as exophthalmos, ocular hyperemia, and diplopia, leading to treatment. Some patients also exhibit reflux into intracranial veins and require caution. Transvenous embolization is the first-line treatment for CSDAVF because of a high radical cure rate. Occasionally, however, a large number of coils are necessary for sinus packing, or neurological symptoms occur due to over packing.3) Moreover, insufficient sinus packing may cause change in the venous drainage route and reflux to cortical veins and result in postprocedural venous congestion and intracranial hemorrhage.6,7)
frontal vein,\textsuperscript{13} retromandibular vein,\textsuperscript{14} superficial temporal vein,\textsuperscript{13,15} direct puncture of the SOV by supraorbital incision, direct sinus packing with craniotomy,\textsuperscript{16,17} and direct puncture of the superficial middle cerebral vein.\textsuperscript{18,19} In addition, techniques such as pulling up the micro-catheter from the contralateral IPS using a gooseneck snare\textsuperscript{20} have been reported. Procedures involving craniotomy or supraorbital incision are highly invasive, and an approach through the internal jugular vein by femoral vein puncture should be selected as often as possible. However, by approaches other than the trans-IPS route, the distance to the cavernous sinus is long and tortuous, and the lesion may be unreachable. Moreover, if the cavernous sinus can be reached, the manipulation of the micro-guidewire and tracking with a micro-catheter may be restricted, and the target shunted pouch may be inaccessible. By the transfacial vein approach through the superior ophthalmic vein, to circumvent this problem, catheter navigation using a triple coaxial system has been attempted.\textsuperscript{10,12} According to previous reports, penetration of the micro-catheter to the SOV and cavernous sinus could be supported by guiding a 4 Fr DAC to a point near the angular vein by a triple coaxial system using a 6 Fr guiding catheter with a 4 Fr DAC, and satisfactory embolization could be achieved. There have been other reports of the use of triple coaxial systems, but, in all these reports, the DAC was navigated only to a point near the angular vein and not beyond the SOV\textsuperscript{10,12} because of the difficulty in access due to meandering of the angular vein and obstruction of venous drainage during treatment due to DAC insertion. In the case presented here, the catheter could be inserted through the angular vein and SOV into the cavernous sinus using a TACTICS with a distal diameter of 3.2 Fr. Since the DAC reached the cavernous sinus, greater freedom of manipulation of the micro-catheter and micro-guidewire in the cavernous sinus is considered to have been secured, and the micro-catheter to have been advanced to the target shunted pouch via an appropriate route. In addition, because of the delivery of the DAC into the cavernous sinus, the micro-catheter was expected to be navigated easily even in the event of the appearance of dangerous drainage during embolization, making appropriate treatment possible. TACTICS is given kink-resistance
and luminal retainability by adopting stainless-steel round wire twin mesh blades and has a luminal diameter of 0.035 inch despite being a micro-catheter 3.4 Fr in proximal external diameter and 3.2 Fr in distal external diameter. For this reason, it can serve as a DAC for micro-catheters widely used for coil embolization such as Excelsior SL10, Headway 17 (MicroVention TERUMO, Tustin, CA, USA), Echelon 10 (Covidien Medtronic, Fridley, Minnesota, USA), and NEURODEO (Medico’s Hirata, Osaka, Japan). In addition, as its distal external diameter (3.2 Fr) is smaller than the 4 Fr Cerulean catheter (Medikit, Tokyo, Japan), it can be delivered to even deeper areas. Also, when the lesion is approached via the drainer vein as in our patient, it is also considered to minimize stenosis of the drainage route and to contribute to the prevention of stagnation of venous drainage and the appearance of new dangerous drainers. However, the total length of TACTICS is 128 cm even in the shortest model, being longer than 4 Fr Cerulean G, and measures to control the catheter length, such as the use of a T-shaped connector, are necessary in its concomitant use with a 150 cm micro-catheter as a DAC.

### Conclusion

Although selective embolization of the shunted pouch is an effective treatment for CSDAVF, adhesion to this treatment may lead to prolongation of the treatment time and an increase in radiation dose. To avoid this, along with accurate preprocedural diagnosis of the shunted pouch, it is important to select an approach route advantageous for accurate and prompt micro-catheter navigation and a guiding system matched to the approach method. In the triple coaxial system used for the transfacial-superior ophthalmic vein approach, the 3.4 Fr TACTICS is considered to have been very useful as a DAC.

### Disclosure Statement

There are no conflicts of interest to disclose.
References