A Patient with a Cavernous Sinus Dural Arteriovenous Fistula in Whom an Approach through the Jugular Venous Arch Involving Facial Vein Return Was Adopted

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Objective: We report the case of a cavernous sinus dural arteriovenous fistula (CSdAVF) treated by transvenous embolization (TVE) via the jugular venous arch (JVA) connecting bilateral superficial cervical veins.

Case Presentation: A male patient in his 50s presenting with diplopia and headache was diagnosed with a CSdAVF. The first session of TVE resulted in incomplete obliteration of the fistula due to poor accessibility through the inferior petrosal sinus (IPS), and postoperative computed tomography angiography (CTA) disclosed a newly developed drainage route into the facial vein (FV) connecting to the anterior jugular vein (AJV) and the JVA. The patient underwent the second session of TVE through the JVA, FV, and the superior ophthalmic vein (SOV), and obliteration was achieved.

Conclusion: There is a considerable variation in the anatomy of facio-cervical veins in patients with CSdAVF. Meticulous preoperative evaluation of the venous drainage route using modern diagnostic tools is indispensable to achieve successful results in patients with CSdAVF.

Keywords ▶ dural arteriovenous fistula, coil embolization, jugular venous arch

Introduction

For the treatment of cavernous sinus dural arteriovenous fistulae (CSdAVFe), transvenous embolization (TVE) using a cavernous sinus (CS) approach via the inferior petrosal sinus (IPS) through the internal jugular vein (IJV) has been established as a safe and effective treatment method. However, in some cases, the CS cannot be reached for anatomical reasons or obliteration is impossible using this trans-IPS route. In such cases, a route to reach the CS through the superior ophthalmic vein (SOV) via the facial vein (FV) is used as an alternative approach.

Case Presentation

The patient was a man in his 50s. He consulted our department for diplopia and headache. Brain magnetic resonance imaging (MRI) suggested a CSdAVF. Cerebral angiography revealed a CSdAVF with an arteriovenous shunt on an extensive area of the dura mater involving the left to medial posterior wall of the left CS, with the dural branches of the bilateral internal and left external carotid arteries as feeders. There was no venous pouch where arterial flows converge, and the outflow routes of draining veins were from bilateral IPSs to the deep jugular vein of the posterior cervix via the anterior condylar confluence, lateral condylar vein, and suboccipital cavernous sinus, and from the inferior left CS to the pterygoid plexus (Fig. 1A–1C). Although the relationship between the IPS and IJV was unclear, TVE to occlude the shunt site around the posterior
wall of the left CS via the IPS following a standard procedure was initially selected.

**Initial endovascular treatment**

Under general anesthesia, a 6Fr Sheathless NV 90 cm (Asahi Intecc, Aichi, Japan) and Cerulean DD6 118 cm (Medikit, Tokyo, Japan) were coaxially inserted through the right femoral vein to reach the right IJV. However, a guidewire was unable to be advanced into the right IJV; thus, the Sheathless was guided into the left IJV. It was difficult to search for the orifice of the IPS, and the combination of a Headway-17 microcatheter 45° (Terumo, Tokyo, Japan) and CHIKAI black 0.014 soft tip (Asahi Intecc) was inserted into the left IPS. However, the route was narrow and the operability was poor. The Headway was transiently guided from the left CS to the right IPS, and the intercavernous sinus and most posterior part of the left CS were embolized while pulling the Headway back (Fig. 2A and 2B). At this point, the end of the Headway was kicked back to the left IPS, making additional insertion into the CS impossible. Angiography demonstrated incomplete obliteration of the arteriovenous
fistula (Fig. 2C). The left and right communications to the outflow tract were partially blocked, and slight regurgitation to the anterior bilateral SOVs was observed. An approach into the CS via the right deep jugular vein and IPS through the right vertebral venous plexus was adopted, but this was also impossible. In addition to an increase in the radiation exposure dose, there was no cortical vein reflux and there were no changes in the ocular findings or neurological symptoms; therefore, elective treatment was considered to be possible. The procedure was completed, planning additional treatment later.

**Clinical course after initial treatment**
Computed tomography angiography (CTA) 2 days after initial treatment demonstrated an outflow tract from the left CS to the JVA via the left SOV, left FV, and left anterior jugular vein (AJV) (Fig. 3A and 3B). There were no marked changes in the symptoms, but a brain MRI after 1 month revealed the progression of left SOV dilation. Additional treatment was promptly scheduled. We decided to adopt the trans-JVA route observed on CTA.

**Second session of endovascular treatment**
Left/right carotid angiography under general anesthesia confirmed the disappearance of the outflow to the left/right IPSs and left pterygoid plexus, which were detected on the previous session. On the other hand, dilation of the left SOV was more remarkable than during the previous treatment session. Blood outflow to the JVA via the left FV and AJV was noted (Fig. 4A). A 6Fr Shuttle Sheath 80 cm and 6Fr Roadmaster 100 cm (Goodman, Aichi, Japan) were coaxially inserted to approach the left AJV through the left brachiocephalic vein, but a sharp bifurcation angle prevented the catheter from following the wire that was guided; therefore, this was abandoned. A Roadmaster was inserted into the right brachiocephalic vein, and a 4Fr Optiflash Benson Hanafee Wilson 120 cm (Terumo) and Radifocus M 0.035 wire (Terumo) were guided into the Roadmaster. By selecting the left AJV via the JVA through the right subclavian vein, the Roadmaster was able to be guided into the left AJV (Fig. 4B). The Optiflash was removed, and a Tactics intermediate catheter 3.2/3.4Fr 130 cm (Technocrat Corporation, Aichi, Japan) and NEWRODEO 10 microcatheter 157 cm (Medico’s Hirata, Osaka, Japan) were coaxially inserted using a CHIKAI black 0.014 soft tip microguidewire (Asahi Intecc). Torsion of the left FV, which joined with the AJV, was slight, and the Tactics was guided into the left angular vein in order for the NEWRODEO to reach the left CS via the left SOV (Fig. 4C). A shunt was present at the posterior medial segment of the left CS. The NEWRODEO was guided to this site and 22 detachable coils were placed (Fig. 5). Bilateral
Discussion

A previous study reported that TVE of CsdAVFe using an IPS-mediated approach led to a high success rate and radical cure regardless of the presence of IPS visualization. However, when an IPS-mediated approach is impossible, an FV- or middle temporal vein-mediated approach or that through the SOV by direct puncture is necessary. Miller et al. reported that patients anatomically free from a communication between the IPS and IJV accounted for ≤1%. In
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9) Naito et al. reported a patient with a carotid cavernous sinus fistula characterized by a return current from the FV to the subclavian vein via the JV A. They incised the mandibular region and directly punctured the FV to approach the CS. As the vascular bifurcation angle between the subclavian vein and JV A is sharp, an approach from the femoral vein to the JV A may be difficult, and there is a method to reach the JV A by EJV or brachial vein puncture. In the present case, an 80-cm-long sheath was inserted through the femoral vein, and a 100-cm guiding catheter was guided into the AJV via the JV A using a 4Fr catheter with a markedly flexible end. In addition, stable microcatheter support was achieved by advancing a Tactics, which was used as an intermediate catheter, to the level of the medial ocular angle. Furthermore, physicians should understand that there are some CSdAVF patients in whom confirmation of JV A presence using CTA facilitates percutaneous TVE, as demonstrated in the present case.

**Conclusion**

We report a patient with a CSdAVF in whom TVE was performed through the JVA to which the FV had returned. In many CSdAVF patients, the standard approach route, the IPS, is occluded. Furthermore, there are many variations in the venous anatomy of the facial cervix. Before surgery, it may be important to evaluate the anatomy of the cervical vein as a return route in detail. For such an assessment, CTA may be useful.
Disclosure Statement
The authors declare no conflict of interest.

References