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Case Report

Cavernous sinus dural arteriovenous fistula accessed through a straightened superficial temporal vein

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ABSTRACT

Background: Transvenous embolization through the inferior petrosal sinus (IPS) is the most common treatment procedure for cavernous sinus dural arteriovenous fistula (CSDAVF). When the IPS is inaccessible or the CSDAVF cannot be treated with transvenous embolization through the IPS, the superficial temporal vein (STV) is used as an alternative access route. However, the approach through the STV is often challenging because of its tortuous and abruptly angulated course. We report a case of recurrent CSDAVF which was successfully treated using a chronic total occlusion (CTO)-dedicated guidewire and by straightening the STV.

Case Description: A 63-year-old woman was diagnosed with CSDAVF on examination for oculomotor and abducens nerve palsy. She was initially treated with transvenous embolization through the IPS. However, CSDAVF recurred, and transvenous embolization was performed through the STV. A microcatheter could not be navigated because of the highly meandering access route through the STV. By inserting a CTO-dedicated guidewire into the microcatheter, the STV was straightened and the microcatheter could be navigated into a shunted pouch of the CS. Finally, complete occlusion of the CSDAVF was achieved.

Conclusion: If an access route is highly meandering, the approach can be facilitated by straightening the access route with a CTO-dedicated guidewire.

Keywords: Cavernous sinus, Dural arteriovenous fistula, Embolization, Transvenous

INTRODUCTION

For the curative treatment of cavernous sinus dural arteriovenous fistulas (CSDAVF), transvenous embolization (TVE) is the first choice, and the inferior petrosal sinus (IPS) is most often selected as an access route to the CS.[13,20] However, other access routes may be required in some cases. We treated a patient with CSDAVF with TVE through the ipsilateral IPS route. However, the CSDAVF recurred and was treated with TVE through the superficial temporal vein (STV). The access route from the STV was significantly tortuous and inaccessible. By straightening the STV with a chronic total occlusion (CTO)-dedicated guidewire, a microcatheter could be navigated to the CS, and complete occlusion of the CSDAVF was achieved. To the best of our knowledge, this report is the first to present a technique for straightening an access route using a CTO-dedicated guidewire.

CASE PRESENTATION

A 63-year-old woman presented with ptosis of the right eye at the ophthalmology department of our hospital. She was suspected to have a CSDAVF on brain magnetic resonance imaging and was referred to our department. On neurological examination, she displayed palsy of the oculomotor and abducens nerves. She had no history of trauma or surgery. Cerebral angiography showed a CSDAVF fed from the left accessory meningeal artery, left artery of foramen rotundum, right meningohypophyseal trunk, and right ascending pharyngeal artery. These feeding arteries converged at the posteromedial compartment of the right CS, formed a shunted pouch, and drained into the right IPS [Figure 1]. The CSDAVF was symptomatic, although not accompanied by cortical venous reflux. Therefore, endovascular treatment was performed. Because the patient had severe asthma, she was sedated and analgesized with dexmedetomidine and pentazocine rather than general anesthesia. The transfemoral venous approach was attempted through the right IPS. The microcatheter was navigated to the right CS, and the shunted pouch was embolized with a coil. During the procedure, the patient complained of pain and was unable to rest. Approximately 5 h after the start of treatment, a small amount of arteriovenous shunt remained [Figure 2], but she remained unable to rest. We decided to discontinue the endovascular treatment. After the operation, the right oculomotor nerve palsy improved but the abducens nerve palsy did not improve.

After 6 weeks from the operation, the patient developed exophthalmos and conjunctival congestion of the right eye and palsy of the oculomotor and abducens nerves worsened. Cerebral angiography showed recurrence of the CSDAVF. The feeder was the right meningohypophyseal trunk, and the shunted pouch was identified as the anterolateral compartment of the right CS. The right superior ophthalmic vein (SOV), the main drainer, drained into the STV [Figure 3]. Exophthalmos, conjunctival congestion, and exacerbation of oculomotor and abducens nerve palsy were observed because venous reflux from the right CS to the SOV occurred. As a treatment route, the right IPS flow was occluded, and it was considered difficult to access the

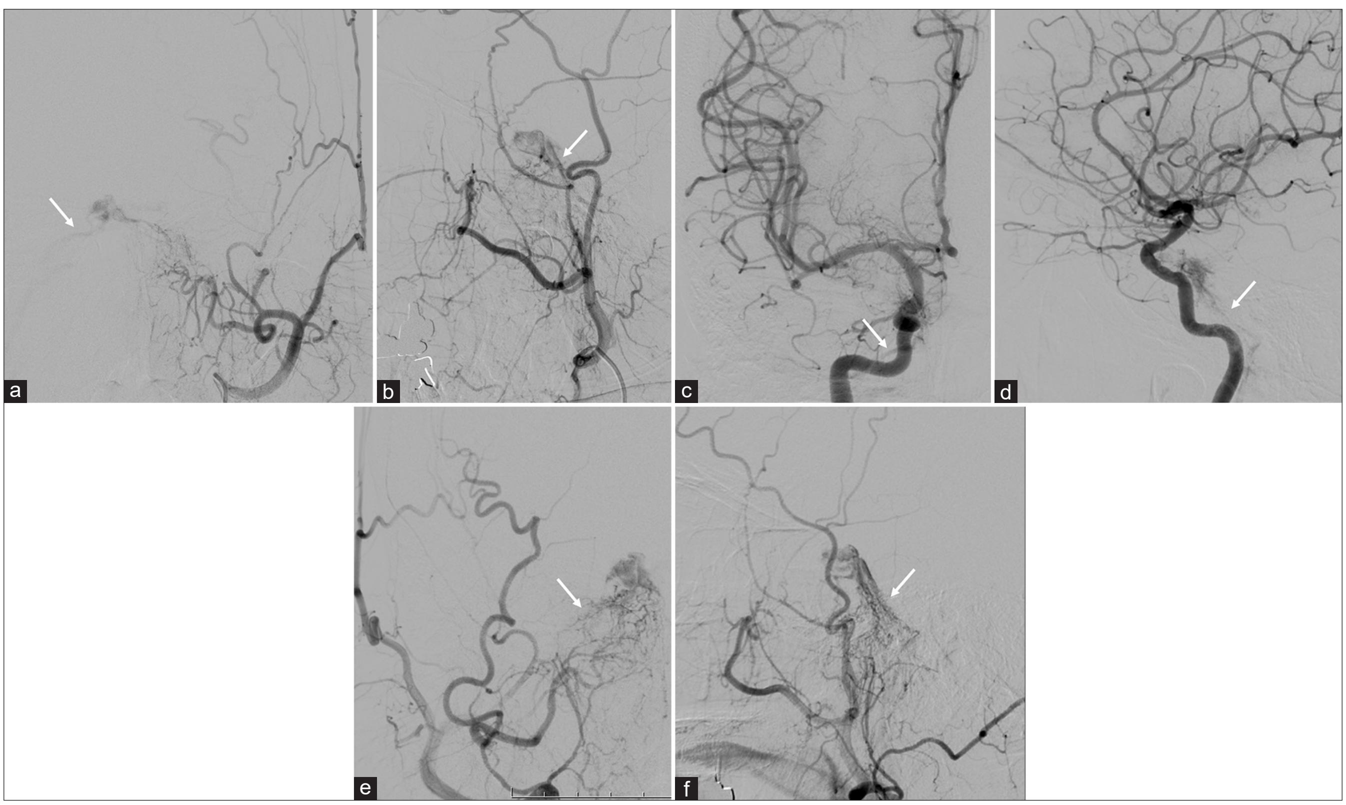

Figure 1: The left external carotid artery angiogram (a: Anteroposterior view, b: Lateral view), the right internal carotid artery angiogram (c: Anteroposterior view, d: Lateral view), and the right external carotid artery angiogram (e: Anteroposterior view, f: Lateral view) show a cavernous sinus dural arteriovenous fistula that is mainly fed by the left accessory meningeal artery, left artery of foramen rotundum (a and b), right meningohypophyseal trunk (c and d), and right ascending pharyngeal artery (e and f). The cavernous sinus dural arteriovenous fistula has a shunted pouch on the posteromedial compartment of the right cavernous sinus and drains into the right inferior petrosal sinus (arrows in a-f).

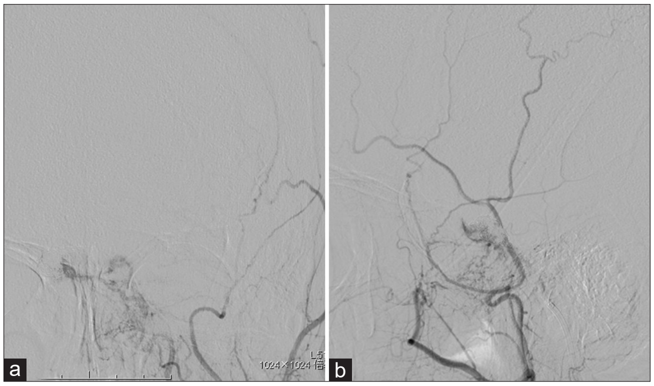

Figure 2: The left external carotid artery angiogram (a: Anteroposterior view, b: Lateral view) shows a slightly residual arteriovenous shunt of the right cavernous sinus.

anterolateral compartment of the right CS through the right IPS. Therefore, the access route from the right STV to the right SOV was selected and TVE of the anterolateral compartment of the right CS was planned.

Endovascular retreatment with transvenous embolization

The patient was sedated with dexmedetomidine and was given pentazocine during endovascular treatment. The transfemoral venous approach with systemic heparinization was performed. For intraprocedural angiography, a 4-F catheter was positioned at the right internal carotid artery. A 5-F Slim Guide guiding catheter 93 cm (Medikit Co., Tokyo, Japan) was positioned at the right external jugular vein. Through the 5-F guiding catheter, a 3.4-F TACTICS 130 cm (Technocrat Corporation, Aichi, Japan), which was used as a distal access catheter, and a CHIKAI black 18 (Asahi Intecc Co., Aichi, Japan), which was a 0.018″ guidewire, were navigated into the right STV from the right retromandibular vein. Subsequently, from the TACTICS, a 1.9-F Carnelian MARVEL nontaper microcatheter 160 cm (Tokai Medical Products Inc., Aichi, Japan) and a Transend 10 microwire (Stryker, Kalamazoo, MI, USA) were used to attempt to advance to the right CS by guiding these through the right STV and the right SOV. The route from the STV to the SOV was tortuous and abruptly angulated. The 5-F guiding catheter was guided to the distal retromandibular vein and the TACTICS was guided as far as possible to distal STV to increase the support of the microcatheter, and the navigation of MARVEL to the right CS was attempted. However, the STV and the SOV were looping, and the right CS was inaccessible. Although various microcatheters and microwires were used and manually stretching the looped STV was attempted, the microcatheter could not be navigated into the right CS. Finally, a 0.014″ ATHLETERUBY PT SUPPORT (Japan Lifeline Co., Tokyo, Japan), a CTO-dedicated guidewire, was inserted into the microcatheter, being careful not to allow the

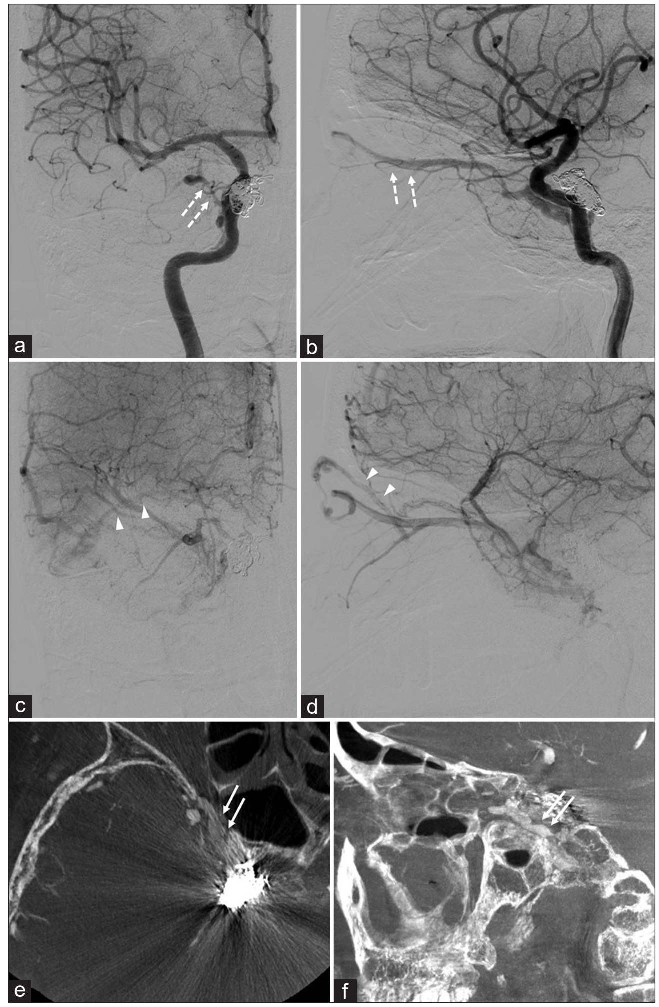

Figure 3: The right internal carotid angiogram (a: Anteroposterior view, b: Lateral view) shows a cavernous sinus dural arteriovenous fistula that is fed by the right meningohypophyseal trunk and drains into the right superior ophthalmic vein (dotted arrows). The venous phase of the right internal carotid angiogram (c: Anteroposterior view, d: Lateral view) shows the cavernous sinus dural arteriovenous fistula draining from the superior ophthalmic vein to the superficial temporal vein (arrowheads), with ipsilateral inferior petrosal sinus occlusion. Axial (e) and sagittal (f) reformatted images of the rotational angiography show a shunted pouch located at the anterolateral compartment of the right cavernous sinus (arrows).

tip of the guidewire come out of the microcatheter, and the STV was linearized [Video 1]. After the TACTICS and the 5-F guiding catheter were guided farther distally, the microcatheter could be easily navigated into the right CS and complete occlusion of the CSDAVF was achieved by coil embolization [Figure 4]. With the continuous infusion of dexmedetomidine at 0.4 μg/kg/h and administration of pentazocine (15 mg) at the start of treatment and 4 h later, the patient was well sedated with no complaints of pain during the endovascular treatment.

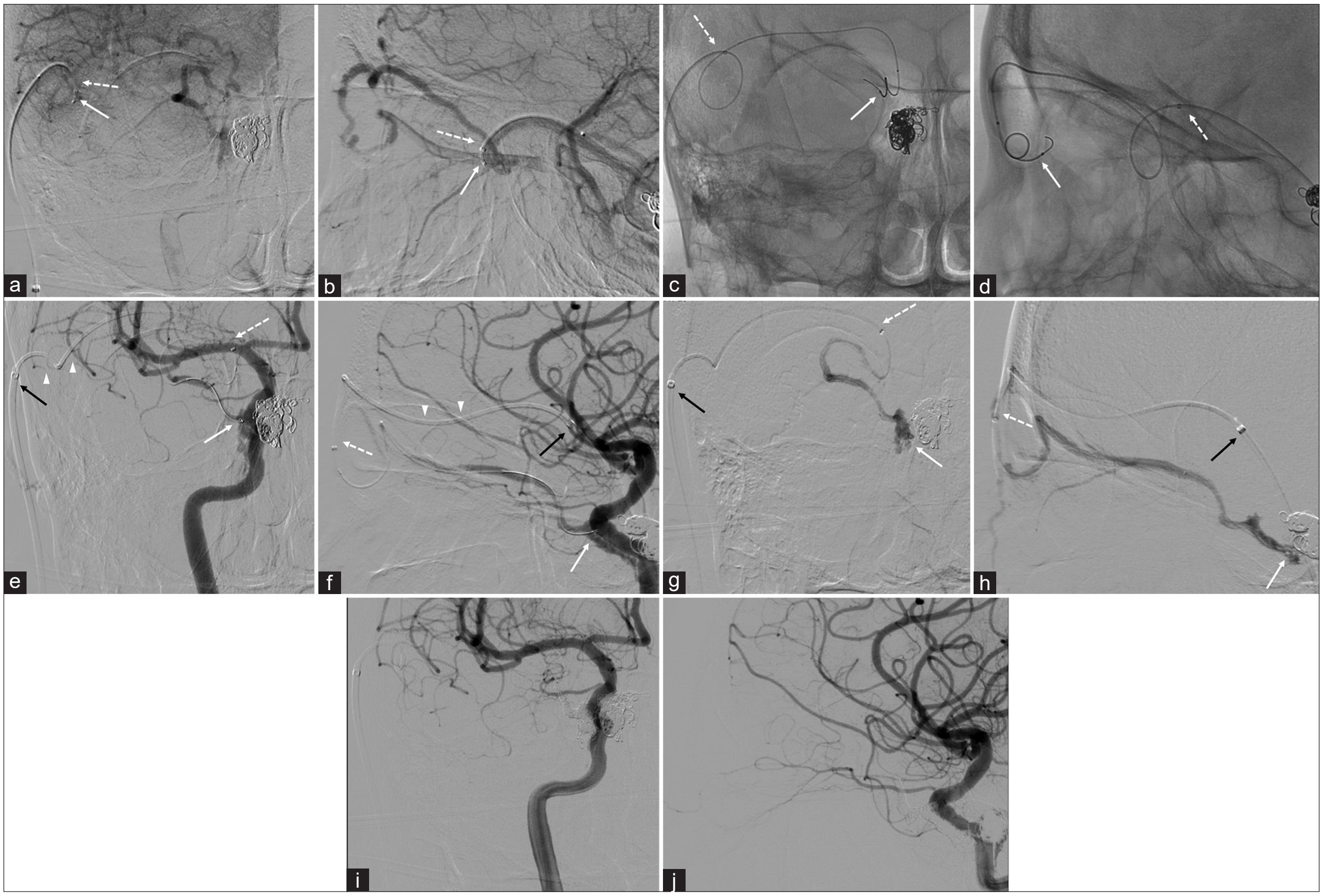

Figure 4: The abruptly angulated and tortuous course from the superficial temporal vein (STV) to the superior ophthalmic vein (SOV) is shown in the Anteroposterior (a) and Lateral (b) views of the right internal carotid artery angiogram and in the Anteroposterior (c) and Lateral (d) views of snapshot images. A microcatheter (white arrows in a-d) cannot be navigated from the STV to the SOV, with a distal access catheter (white dotted arrows in a-d) guided into the STV. The right internal carotid artery angiogram (e: Anteroposterior view, f: Lateral view) shows the straightened STV route (white arrowheads in e and f) by inserting an ATHLETERUBY PT guidewire into the microcatheter. The distal access catheter can be guided from the STV to the angular vein (white dotted arrows in e-h) and a 5-F guiding catheter can guided from the distal retromandibular vein to the STV (black arrows in e-h). The microcatheter (white arrows in e-h) can be navigated into a shunted pouch of the right cavernous sinus and the microcatheter injection (g: Anteroposterior view, h: Lateral view) reveals the shunted pouch of the right cavernous sinus draining into the SOV. Transvenous coil embolization is performed and complete occlusion of cavernous sinus dural arteriovenous fistula is achieved on postprocedural angiography (i: Anteroposterior view, j: Lateral view).

Postoperative course

After the second operation, exophthalmos and conjunctival congestion and the palsy of oculomotor and abducens nerves disappeared. There was no recurrence during the 3 years of observation.

DISCUSSION

TVE is the first-line curative treatment for CSDAVF, and the success rate of complete occlusion of the fistula by TVE is reported to be 81–82%.[12,20] It has been reported that IPS was the most selected access route to the CS and could approach the CS in 90% of patients.[20] However, when the IPS is inaccessible or it is difficult to treat the CSDAVF with TVE through the IPS route, various alternative access routes, such as the superior petrosal sinus,[16] the pterygoid plexus,[9] the facial vein (FV),[3,13] and the STV,[8] have been reported. The usefulness of direct puncture of the SOV,[2] FV,[1,15] STV,[11] and frontal vein,[19] and direct puncture of the Sylvian vein by craniotomy[14] has also been reported.

In this case, direct puncture of the STV or the SOV may have been considered an alternative treatment route, but direct puncture of the STV may cause occlusion due to STV injury. If the STV is occluded and a new drainage route from the SOV to the FV does not appear, congestion of the ophthalmic veins can cause increased intraocular pressure, which results in visual impairment. Furthermore, in such a case, only direct puncture of the SOV can be used as an approach route. For direct puncture of the SOV, various complications, such as puncture-related intraorbital hemorrhage, injury of the levator muscle and supraorbital nerve, orbital infection, granulomas, damage to the trochlear nerve, and nonarteritic ischemic optic neuropathy, have been reported.[6,17,18] Moreover, if the SOV is occluded due to SOV injury and retrograde cortical venous drainage occurs, the CSDAVF becomes an aggressive lesion with a risk for intracranial hemorrhage. For these reasons, the transfemoral venous approach is preferred over direct puncture of the STV or the SOV.

The approach from the STV or FV to the SOV is often difficult to achieve due to significant meandering and steep flexion of the route. To solve this problem, there are methods to manually unbend the veins or to guide using a triple coaxial system.[4,21] In addition, a method, wherein a microcatheter is navigated by making a microwire loop and using it as an anchor, has been reported.[5] In this case, both the STV and the SOV were looped, and the access route was tortuous and abruptly angulated. Therefore, in endovascular treatment, a distal access catheter was used while trying to manually unbend the STV, and multiple microcatheters/microwires were used. However, the CS could not be accessed. Finally, by inserting a 0.014″ ATHLETERUBY PT guidewire into the microcatheter, the STV could be straightened and the microcatheter could be easily navigated into the CS.

The ATHLETERUBY PT guidewire is a CTO-dedicated guidewire used for CTO of peripheral blood vessels.[10] In neuroendovascular treatment, the ATHLETERUBY PT guidewire has been reportedly used to cross the lesion in angioplasty and stenting of CTO of the internal carotid artery.[7] We especially prefer to use this CTO-dedicated guidewire for crossing the lesion in stenting of subclavian artery occlusion. The ATHLETERUBY PT guidewires are 0.014″ and hydrophilic CTO-dedicated guidewires, and range from SOFT type to SUPERHARD type, depending on the difference in tip loads and penetration power. In addition, there is a SUPPORT type with moderate shaft rigidity. In this case, the SUPPORT type was used to straighten the looped STV. Because the tip of this guidewire is hard, to prevent venous injury, it is important to use this guidewire without sticking out the tip from the microcatheter.

CONCLUSION

We treated a patient with CSDAVF through ipsilateral IPS, however, it recurred and was retreated through the STV. Although the access route from the STV to the SOV was tortuous and abruptly angulated, access to the CS was achieved by straightening the STV with a CTO-dedicated guidewire. Finally, the CSDAVF was diminished. If the access route is highly meandering, straightening the route with a CTO-dedicated guidewire can facilitate the approach.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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