

Case Report

Transvenous Embolization of Cavernous Sinus Dural Arteriovenous Fistula through the Angiographically Occlusive Superior Ophthalmic Vein

Abstract

Transvenous embolization (TVE) through the superior ophthalmic vein (SOV) is a useful approach for the treatment of cavernous sinus (CS) dural arteriovenous fistulae (DAVFs). This venous route is usually confirmed by angiography. Herein, we present a case of favorable embolization of the CS DAVF through the angiographically occlusive SOV. A 61-year-old man presented with progressive exophthalmos and hypertension. The patient was diagnosed with a CS DAVF, and TVE was planned. The first approach through the inferior petrosal sinus was infeasible; therefore, we attempted to approach the fistula through the left facial vein. The microcatheter was easily advanced to the shunt point through the angiographically occlusive SOV. We performed coil embolization, and the CS DAVF was completely obstructed.

Keywords: Angiography, cavernous sinus dural arteriovenous fistula, exophthalmos, facial vein, superior ophthalmic vein, transvenous embolization

Introduction

Cavernous sinus (CS) dural arteriovenous fistula (DAVF) is a subtype of intracranial DAVF. CS DAVFs often cause clinical symptoms, especially in eye fields. In contrast, cases with aggressive symptoms are fewer in number.^[1]

Transvenous embolization (TVE) is the standard treatment for CS DAVFs. The inferior petrosal sinus (IPS) is the most common route for approaching CS. The transvenous approach from a facial vein (FV) through a superior ophthalmic vein (SOV) is often reported as an alternate route,^[2,3] commonly confirmed by angiography. Herein, we report a rare case of successful TVE of a CS DAVF from a FV through the angiographically occlusive SOV.

Case Report

Informed consent was obtained from the patient for the publication of this case report and accompanying images.

A 61-year-old man with progressive left exophthalmos and ocular hypertension was admitted to our hospital. He had no history of medication or trauma. Computed

tomography and magnetic resonance imaging (MRI) revealed left exophthalmos and dilatation of the ipsilateral SOV [Figure 1a-c]. Time-of-flight MRI showed a high-intensity signal in the left CS [Figure 1d]. Digital subtraction angiography (DSA) demonstrated an arteriovenous fistula on the left CS; it was fed by the meningeal branch originating from the CS segment of the left internal carotid artery [Figure 2a-c]. Its draining routes were the left superior and inferior ophthalmic veins connected to the left internal jugular vein through the ipsilateral and deep FVs [Figure 2d-f]. Bilateral IPSs were angiographically obstructed. The patient was diagnosed with CS DAVF (Barrow type D), and we tried to occlude the fistula by TVE. We considered approaching it from the ipsi- or contralateral IPS as the first route. If infeasible, we planned to approach it from the ipsilateral deep FV as a second route.

TVE was performed under intravenous anesthesia with dexmedetomidine. A 5-Fr ENVOY catheter was placed in the left common carotid artery, and a 6-Fr ENVOY catheter was placed in the left internal jugular vein. Initial left common carotid

**Shigeta Moriya,
Shingo Maeda,
Motoharu
Hayakawa¹,
Kiyonori Kuwahara**

*Department of Neurosurgery,
Nishichita General Hospital,
Tokai, Aichi, ¹Department of
Neurosurgery, Fujita Health
University, Toyoake, Japan*

Address for correspondence:

*Dr. Shigeta Moriya,
Department of Neurosurgery,
Nishichita General Hospital,
3-1-1, Nakanoike, Tokai, Aichi,
Japan.
E-mail: shmoriya@me.com*

Access this article online

Website: www.asianjns.org

DOI: 10.4103/ajns.AJNS_71_21

Quick Response Code:



This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Moriya S, Maeda S, Hayakawa M, Kuwahara K. Transvenous embolization of cavernous sinus dural arteriovenous fistula through the angiographically occlusive superior ophthalmic vein. *Asian J Neurosurg* 2021;16:610-3.

Submitted: 19-Feb-2021

Revised: 14-Mar-2021

Accepted: 10-Apr-2021

Published: 14-Sep-2021

angiography showed a drainage different from that seen in diagnostic DSA. The left SOV and left deep FV, planned as the second route, could not be confirmed; hence, only the tortuous FV drainage route remained [Figure 3]. We tried to approach the left CS from the ipsi- or contralateral IPS, as scheduled, but could not reach the shunt point. Other visible approach routes could not be confirmed without the tortuous FV drainage; hence, we approached the left CS from the left FV route. Subsequently, the microguidewire was smoothly advanced in the angiographically occlusive angular vein (AV) and SOV, and it reached the shunt

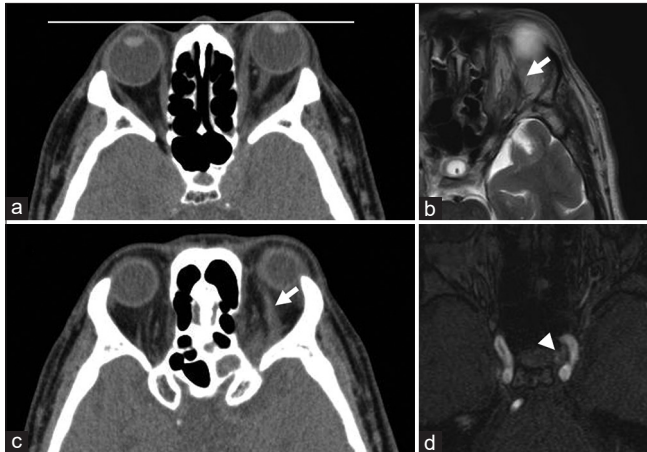


Figure 1: Computed tomography and magnetic resonance imaging at the first examination. (a and b) Computed tomography image showing left exophthalmos (line) and dilatation of the superior ophthalmic vein (arrow). (c and d) Magnetic resonance imaging T2-weighted image and time-of-flight image showing dilatation of superior ophthalmic vein (arrow) and high-intensity signal in the left cavernous sinus (arrowhead)

point [Figure 4]. We performed coil embolization, and the CS DAVF was completely occluded [Figure 5]. The patient's eye symptoms immediately improved. He was followed up for more than 1 year, with no recurrence.

Discussion

DAVF is a rare arteriovenous malformation disease with an unclear etiology. The elevation of venous pressure by venous occlusive changes is believed to cause a widening of physiological anastomosis between the dura maters.^[4,5] A few cases of DAVF are caused by trauma, infection, surgery, tumor, and venous thrombosis, but most cases are idiopathic.

The detection rate of DAVF is approximately 0.16–0.51 per 100,000 adults.^[6-8] Previous studies from Western countries have reported that the most frequent location of DAVFs was the transverse-sigmoid sinus, followed by the CS.^[7] In contrast, the CS was reported as the most frequent location of DAVFs in Asian populations.^[1] Hence, the distribution of the shunt point may vary with regions.

Among patients with CS DAVF, aggressive symptoms were present in only 3% of the cases; however, almost all of them had clinical symptoms.^[1] The common clinical symptoms were sixth cranial nerve palsy (77%), exophthalmos (65%), chemosis (59%), third cranial nerve palsy (59%), visual loss (41%), pulsatile tinnitus (41%), headaches (18%), and retro-orbital pain (18%).^[2] DAVFs with retrograde leptomeningeal venous drainages or other annoying symptoms have been treated with a variety of procedures, including

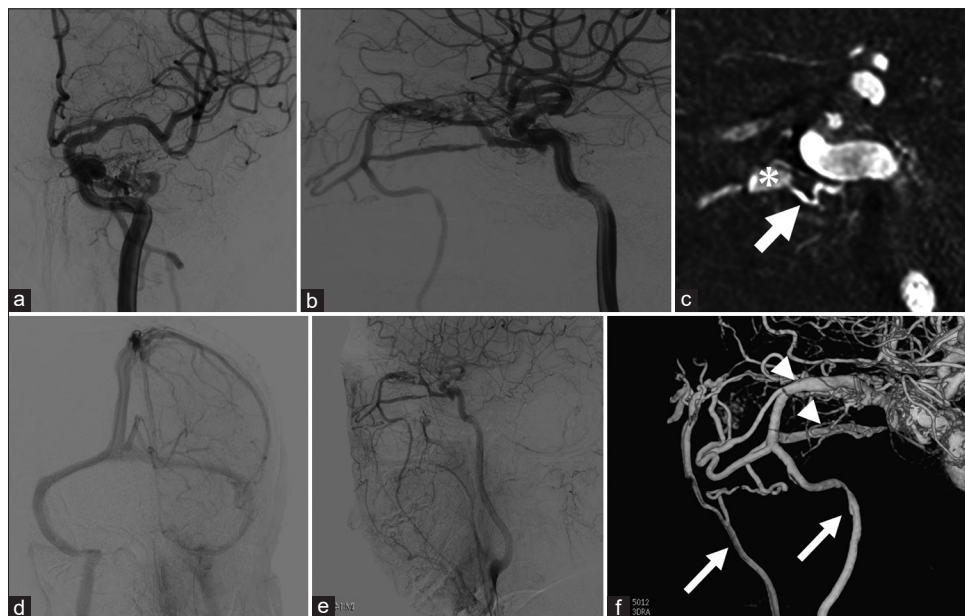


Figure 2: Initial digital subtraction angiography and three-dimensional rotational angiography. (a and b) Early phase of left internal carotid angiography; frontal (a) and lateral (b) view revealing cavernous sinus dural arteriovenous fistula. (c) Multiplanar reconstruction of three-dimensional rotational angiography shows the feeder from the meningeal branch of the left internal carotid artery (arrow) and shunt pouch (asterisk). (d-f) Left internal carotid angiography; frontal view at late phase (d), lateral view at intermediate phase (e), and three-dimensional rotational angiography (f). Cavernous sinus dural arteriovenous fistula drains to the left facial and deep facial veins (arrows) through the superior and inferior ophthalmic veins (arrowheads)

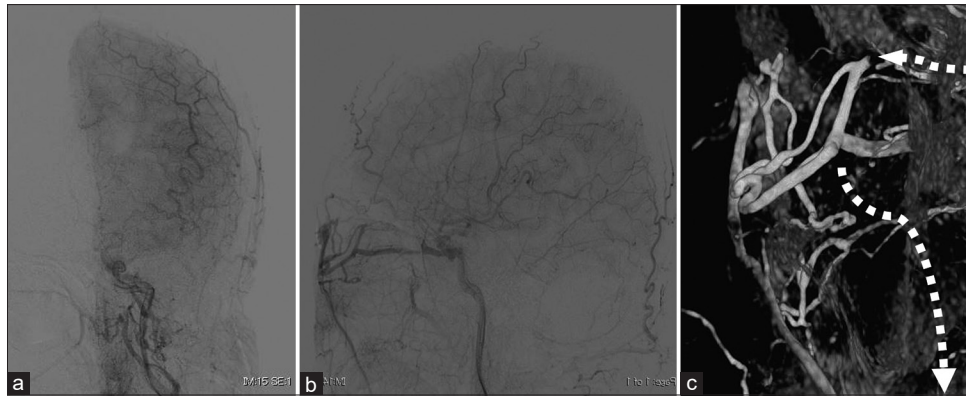


Figure 3: Intraoperative digital subtraction angiography frontal (a) and lateral (b) view at late phase of the left internal carotid artery and three-dimensional rotational angiography (c) The superior ophthalmic vein and the deep facial vein are obstructed (dotted arrow). Only the tortuous facial route remained

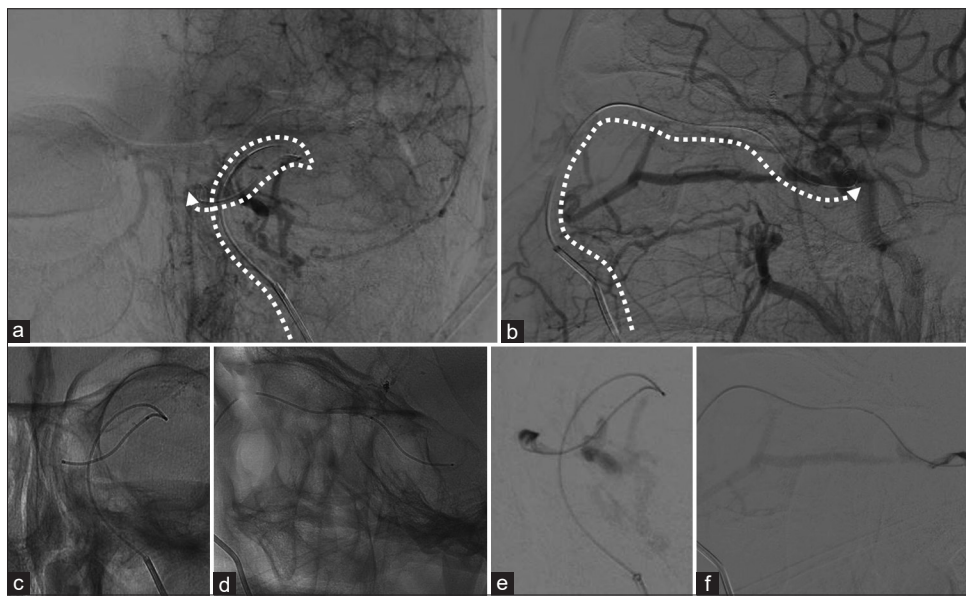


Figure 4: Catheterization to the shunt point of cavernous sinus dural arteriovenous fistula. (a and b) The microcatheter is advanced to the shunt point in the cavernous sinus through the occlusive angular and superior ophthalmic vein (dotted arrow). (c and d) Projection X-ray imaging; frontal (c) and lateral (d) view. (e and f) Selective angiography from the microcatheter; frontal (e) and lateral (f) view

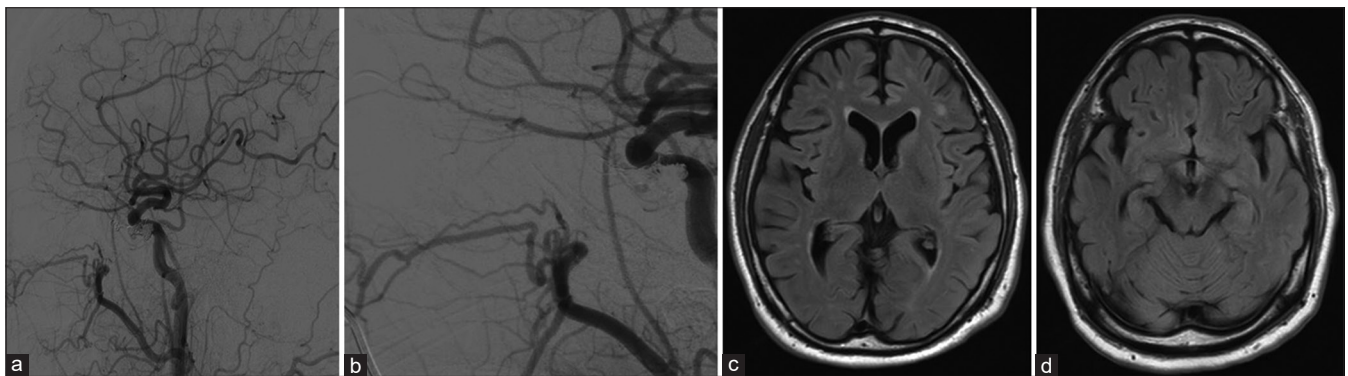


Figure 5: Follow-up digital subtraction angiography and magnetic resonance imaging. (a and b) Follow-up digital subtraction angiography lateral view; cavernous sinus dural arteriovenous fistula is completely occluded. (c and d) Magnetic resonance imaging demonstrates no complication in the follow-up period

endovascular embolization, direct surgery, radiation surgery, or a combination of these. The treatments were

primarily endovascular, with success rates of 62%–81% for transvenous approaches.^[9,10]

Every draining route connecting the CS is a probable approach route. The IPS is the most common venous route for approaching the CS and could be used even if it is occluded. In case the IPS approach is infeasible, other approach routes are considered. The FV is often reported as an alternate route for approaching the CS, and its effectiveness is well known.^[2,3] This route is commonly confirmed by angiography, and it usually reaches the CS through the AV and SOV.

In the present case, the approach from the IPS was infeasible. The deep FV, considered as the second route, was angiographically occluded in the intraoperative DSA. Only the tortuous FV drainage route remained. Severe tortuosity and a steep angle at the junction of the AV and SOV sometimes prevent the passage of a microcatheter from the FV. However, the microguidewire was smoothly advanced to the CS through the angiographically occlusive AV and SOV. The microcatheter was advanced to the CS across the microguidewire. We embolized the shunt point using coils.

The reasons the FV route showed that dynamic angiographic changes for a short period of time are not yet clear; however, venous thrombosis or a hemodynamic change was considered. The general condition and vital signs of the patient were similar to those of diagnostic DSA. An intrajugular catheter was placed, which sometimes stagnates venous drainage, but there was no venous congestion during the procedure. CS DAVFs have been reported to show angiographic changes attributable to progressive thrombosis.^[11] The shortest interval of drainage change was 7 days in this series, which is shorter than that in previous reports.

The angiographic change possibly showed an early phase of thrombosis, which might be an important factor for successful treatment. TVE from the FV route is less invasive; therefore, it is worth trying before attempting to approach other invasive procedures.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Hiramatsu M, Sugiu K, Hishikawa T, Haruma J, Tokunaga K, Date I, *et al.* Epidemiology of dural arteriovenous fistula in Japan: Analysis of Japanese registry of neuroendovascular therapy (jr-net2). *Neurol Med Chir* 2014;54:63-73.
2. Klisch J, Huppertz HJ, Spetzger U, Hetzel A, Seeger W, Schumacher M. Transvenous treatment of carotid cavernous and dural arteriovenous fistulae: Results for 31 patients and review of the literature. *Neurosurgery* 2003;53:836-56.
3. Yu SC, Cheng HK, Wong GK, Chan CM, Cheung JY, Poon WS. Transvenous embolization of dural carotid-cavernous fistulae with transfacial catheterization through the superior ophthalmic vein. *Neurosurgery* 2007;60:1032-7.
4. Terada T, Higashida RT, Halbach VV, Dowd CF, Tsuura M, Komai N, *et al.* Development of acquired arteriovenous fistulas in rats due to venous hypertension. *J Neurosurg* 1994;80:884-9.
5. Kojima T, Miyachi S, Sahara Y, Nakai K, Okamoto T, Hattori K, *et al.* The relationship between venous hypertension and expression of vascular endothelial growth factor: Hemodynamic and immunohistochemical examination in a rat venous hypertension model. *Surg Neurol* 2007;68:277-84.
6. Al-Shahi R, Bhattacharya JJ, Currie DG, Papanastassiou V, Ritchie V, Roberts RC, *et al.* Scottish intracranial vascular malformation study collaborators: Prospective, population-based detection of intracranial vascular malformations in adults: The Scottish intracranial vascular malformation study (SIVMS). *Stroke* 2003;34:1163-9.
7. Piippo A, Niemelä M, van Popta J, Kangasniemi M, Rinne J, Jääskeläinen JE, *et al.* Characteristics and long-term outcome of 251 patients with dural arteriovenous fistulas in a defined population. *J Neurosurg* 2013;118:923-34.
8. Kuwayama N. Epidemiologic survey of dural arteriovenous fistulas in Japan: Clinical frequency and present status of treatment. *Acta Neurochir Suppl* 2016;123:185-8.
9. Lucas CP, Zabramski JM, Spetzler RF, Jacobowitz R. Treatment for intracranial dural arteriovenous malformations: A meta-analysis from the English language literature. *Neurosurgery* 1997;40:1119-30.
10. Kirsch M, Henkes H, Liebig T, Weber W, Esser J, Golik S, *et al.* Endovascular management of dural carotid-cavernous sinus fistulas in 141 patients. *Neuroradiology* 2006;48:486-90.
11. Satomi J, Satoh K, Matsubara T, Nakajima N, Nagahiro S, *et al.* Angiographic changes in venous drainage of cavernous sinus dural arteriovenous fistulae after palliative transarterial embolization or observational management: A proposed stage classification. *Neurosurgery* 2005;56:494-502.