doi: 10.2176/jns-nmc.2021-0293

NMC Case Report Journal 9, 43-47, 2022

Usefulness of a Curved Multiple Reconstruction Image for Transarterial Intravenous Coil Embolization of a Dural Arteriovenous Fistula of the Sphenobasal Vein: A Case Report

Tomotaka OHSHIMA,[1] Mao YOKOTA,[2] Koichiro OGURA,[3] Megumi KOIWAI,[2] Naoki MATSUO,[2] and Shigeru MIYACHI[1,2]

[1]Neuroendovascular Therapy Center, Aichi Medical University, Nagakute, Aichi, Japan
[2]Department of Neurological Surgery, Aichi Medical University, Nagakute, Aichi, Japan
[3]Department of Neurosurgery, Meijo Hospital, Nagoya, Aichi, Japan

Abstract

Hemorrhagic isolated dural arteriovenous fistulas (DAVFs) are often challenging to treat. Here, we report a case of the lateral cavernous sinus (CS) DAVF successfully treated by transarterial intravenous coil embolization using a curved multiplanar reconstruction (MPR) image assistance. A 54-year-old man presented with a severe headache and was diagnosed with subarachnoid hemorrhage caused by CSDAVF. Angiography indicated that the fistula was fed by branches of the left external carotid artery and drained into cortical veins. There were multiple shunting points at the left sphenobasal vein accompanied by varicose veins. Using curved MPR images, the left accessory meningeal artery was chosen for the endovascular approach into the affected veins, including ruptured varix. The shunt was completely occluded by detachable coils.
When the curved MPR image indicates a developing feeding artery and a large shunting point, transarterial intravenous coil embolization becomes a good treatment option for CSDAVF, which has no venous access.

Keywords: accessory meningeal artery, curved multiplanar reconstruction, dural arteriovenous fistula, embolization

Introduction

The cavernous sinus (CS) dural arteriovenous fistulas (DAVFs) can be treated in different ways depending on patients' characteristics. Various treatment approaches include endovascular operation, direct surgery, and stereo radiosurgery; however, the endovascular approach is the first line in most cases. The transvenous approach via inferior petrosal sinus (IPS) is considered the most effective method for endovascular treatment of CSDAVF.[1] If the ipsilateral IPS is occluded or thrombosed, the IPS can be navigated with a microcatheter, or, sometimes, a contralateral approach through the inter-CS can be used.[2,3] Other options for the transvenous approach are the superior ophthalmic vein (SOV), superior petrosal sinus (SPS), and superficial middle cerebral vein (SMCV) with a small craniotomy, among others.[4,5] The transarterial intravenous approach is a feasible but challenging treatment option. Here, we report a case of the sphenobasal vein DAVF successfully treated by transarterial intravenous coil embolization using a curved multiplanar reconstruction (MPR) image assistance.

Case Report

A 54-year-old man was transported to the emergency department complaining of a sudden onset of severe headache. He did not present proptosis, chemosis, or bruit. He had no particular medical history. On admission, his Glasgow coma scale score was E3V5M6; no neurological deficits were observed. Noncontrast computed tomography and contrast three-dimensional angiography revealed a dif-

Received September 2, 2021; Accepted January 20, 2022

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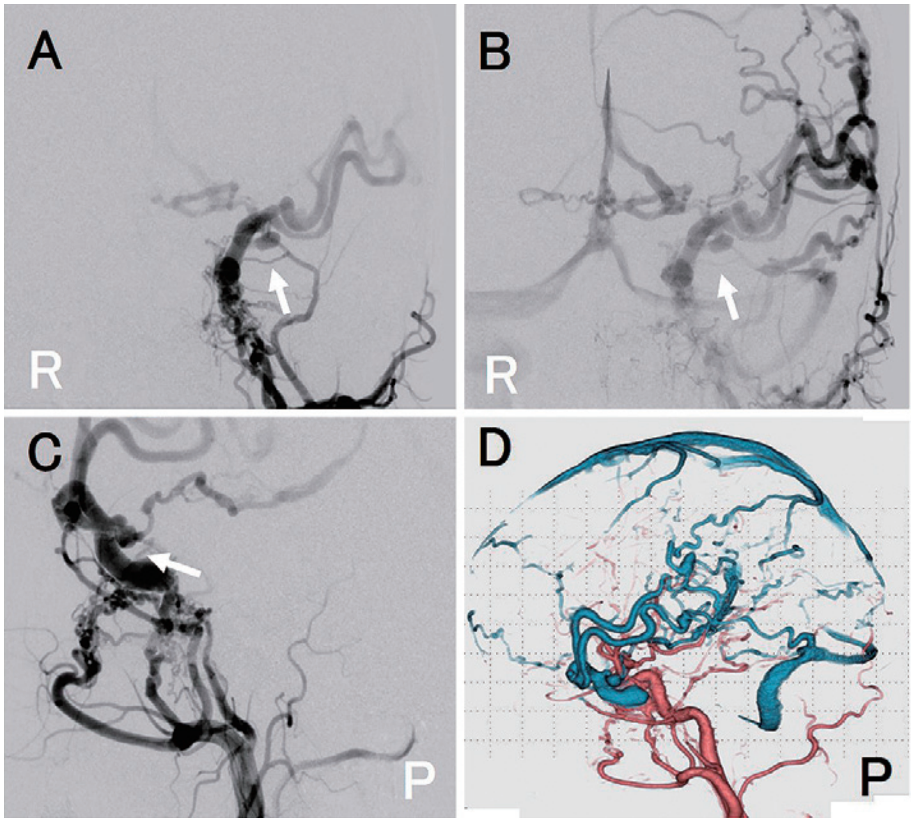

Fig. 1 Preoperative angiography.
The white arrow indicates the varix. R indicates the right. P indicates the posterior. A: Early phase anterior–posterior view of left external carotid angiography showing arteriovenous fistula. B: Late phase anterior–posterior view of left external carotid angiography showing much venous reflux. C: Lateral view of left external carotid angiography showing that the varix exists at the origin of the uncal vein. D: Reconstructed three-dimensional image showing the vasculature.

fuse subarachnoid hemorrhage, predominantly in the left sylvian fissure, caused by the rupture of a DAVF. A diagnostic catheter angiography revealed the presence of a left lateral CSDAVF. The main feeders were the left middle meningeal artery, left accessory meningeal artery (AMA), and the left artery of the foramen rotundum (Fig. 1). There were multiple shunting points around the left sphenobasal vein. The draining veins were the left SMCVs and the left basal vein of Rosenthal via the uncal vein. There was, possibly, a ruptured varix at the origin of the left uncal vein. The SOV, inter-CS, SPS, and IPS were not drainage routes, as they had no connection to the medial CS. The patient was transferred to our hospital for endovascular treatment on Day 1.

Our treatment strategy was the following: a palliative transarterial feeder occlusion as emergency treatment followed by a radical transvenous embolization via the SMCV with a small craniotomy in the subacute phase as there was no better candidate to access the shunting points using a transvenous approach. However, the curved MPR imaging by rotational digital subtraction angiography indicated that the left AMA looked thick enough to approach the venous side from the arterial side (Fig. 2). Aquarius iNtuition (TeraRecon Inc., Durham, NC, USA) was used for neuroimaging analysis. The image indicated that the minimum diameter of the AMA was 1.97 × 2.42 mm at the point of the foramen ovale. The diameter of the shunting point was 2.38 × 3.68 mm. Therefore, we decided on a transarterial intravenous embolization via the left AMA. An oral and written informed consent was given to the patient and his next of kin before the treatment.

Under general anesthesia, a 6-Fr sheath was inserted into the right femoral artery, and a 6-Fr guiding catheter was advanced into the left external carotid artery. A Headway DUO microcatheter (Terumo, Tokyo, Japan) was navigated into the left AMA using a Chikai 14 black microguidewire (Asahi Intecc, Aichi, Japan). A 3.2/3.4-Fr GuidePost 120-cm (Tokai Medical Products, Aichi, Japan) was coaxially used as a distal access catheter (Fig. 3). The microcatheter could be navigated into the venous side smoothly. Even the Guide Post could be advanced through the shunting point. The refluxed veins including the varix were occluded using detachable coils. Finally, the shunt completely disappeared (Fig. 4). The patient's postoperative clinical course was favorable. No neurological deficits were observed, and the patient was discharged 14 days after ad-

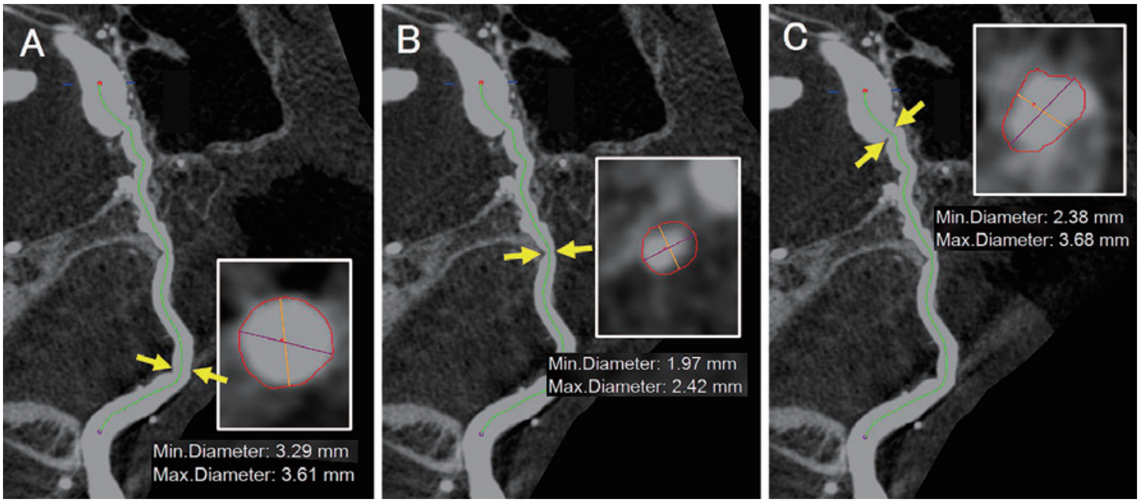

Fig. 2 Curved multiplanar reconstruction images of the left accessory meningeal artery (AMA).
A: At the origin of the AMA from the internal maxillary artery. B: At the foramen ovale. C: At the shunting point from the AMA to the venous side.

mission.

Discussion

The treatment of CSDAVF is difficult. Generally, a transvenous embolization is the first line of treatment. Patency of IPS on the side of the shunt typically provides a straightforward path for access and closure of affected CS. Even if the ipsilateral IPS is occluded, passing a microcatheter through the IPS to the CS is easy. Moreover, the patency of contralateral IPS may permit access through the inter-CS to the affected CS.[1-3] When both IPSs are occluded, we can choose to access there through the facial vein or SOV.[4] However, in this study, the fistulous connection was located in the sphenobasal vein, not inside of the CS. The venous drainage refluxed through the SMCVs and basal vein of Rosenthal. This DAVF is classified as Borden type III and Cognard type IV.[6,7]

Here, transvenous embolization via the vein of Trolard or vein of Labbe was considered to make it too difficult to reach the shunting point because of the long-distance and tortuous course, even if a long and thin microcatheter was used.

Before the operation, we checked curved MPR images using the rotational digital subtraction angiography. The postprocessing software that we used was a commercially available application, Aquarius iNtuition (TeraRecon Inc., Durham, NC, USA). Using the application, automated creation of the vascular images included three-dimensional volume-rendering images, both straight and stretch curved planar reformation images and the cross-sectional multiplanar reconstruction images.[8,9] Those images of the target vessels were obtained after manual tracing of the vessels on the maximum intensity projection image (Fig. 2). It indicated that one of the multiple feeders looked thick enough to approach from the arterial side. The minimum diameter of the left AMA was 1.97 × 2.42 mm at the point of the foramen ovale. The 0.014-inch guidewire and microcatheter could be navigated easily. Moreover, the distal access catheter, with an outer diameter of 1.08 mm could also be navigated easily into the venous side. The 3.2-Fr. Guide Post played an important role in stabilizing the microcatheter during coil embolization, avoiding its migration into the distal maxillary artery.

The transarterial venous embolization had been reported in only a few cases in the literature. Tokunaga et al. described a case of a transverse-sigmoid sinus DAVF that was successfully treated by selective venous embolization through the transarterial microcatheter.[10] Takegami et al. reported that a case of the CSDAVF was successfully treated with selective transarterial embolization through the AMA.[11] Although the shunt had been occluded at the fistulous point because of the single shunt, the wire reached apparently from the arterial side to the venous side in the image presented. Yamauchi et al. reported that a case of CSDAVF was successfully treated with selective transarterial embolization through the AMA.[12] They had selected the transarterial approach because the ipsilateral IPS was occluded. These reports were informative, although they were in a different location from our case.

Conclusion

We report a case of sphenobasal vein DAVF successfully treated by transarterial intravenous coil embolization via AMA, using curved MPR image assistance.

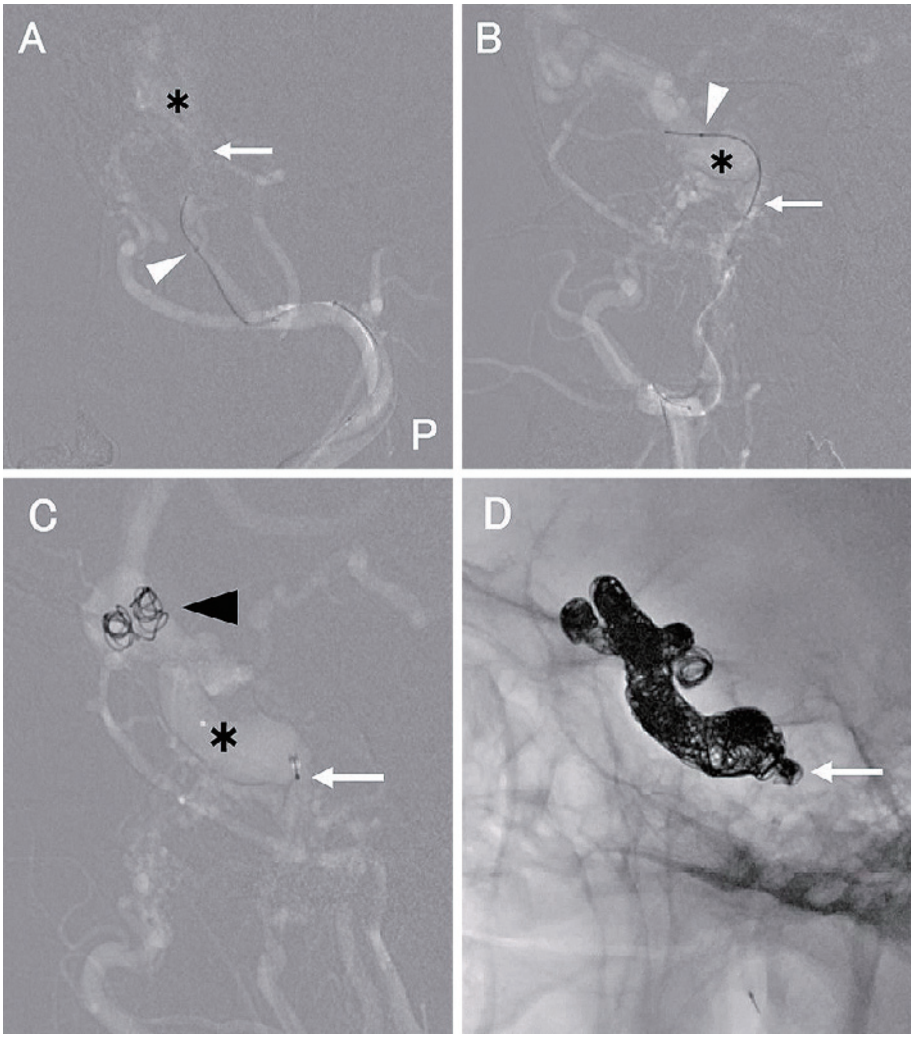

Fig. 3 Intraoperative images.
The asterisk indicates the lateral cavernous sinus (CS). The white arrows indicate the shunting point. The white arrowheads indicate the tip of the microcatheter. A: Lateral view of a roadmap image showing the microcatheter advancing in the accessory meningeal artery (AMA). P indicates the posterior. B: Oblique view of a roadmap image showing that the microcatheter is inside the lateral CS. C: The black arrowhead indicates the first coil in the superficial middle cerebral veins. The tip of the distal access catheter is passed through the shunting point. D: The final coil configuration showing that the coil was filled up to the end of the AMA.

Acknowledgments

None.

List of Abbreviations

AMA, accessory meningeal artery; CS, cavernous sinus; DAVF, dural arteriovenous fistula; IPS, inferior petrosal sinus; MPR, multiplanar reconstruction; SMCV, superficial middle cerebral vein; SOV, superior ophthalmic vein; SPS, superior petrosal sinus

Funding Sources

This research did not receive any specific grant from funding agencies in the public, commercial, and not-for-profit sectors.

Conflicts of Interest Disclosure

None. All authors who are members of the Japan Neurosurgical Society (JNS) have registered themselves through online Self-reported COI disclosure statement forms on the website for JNS members.

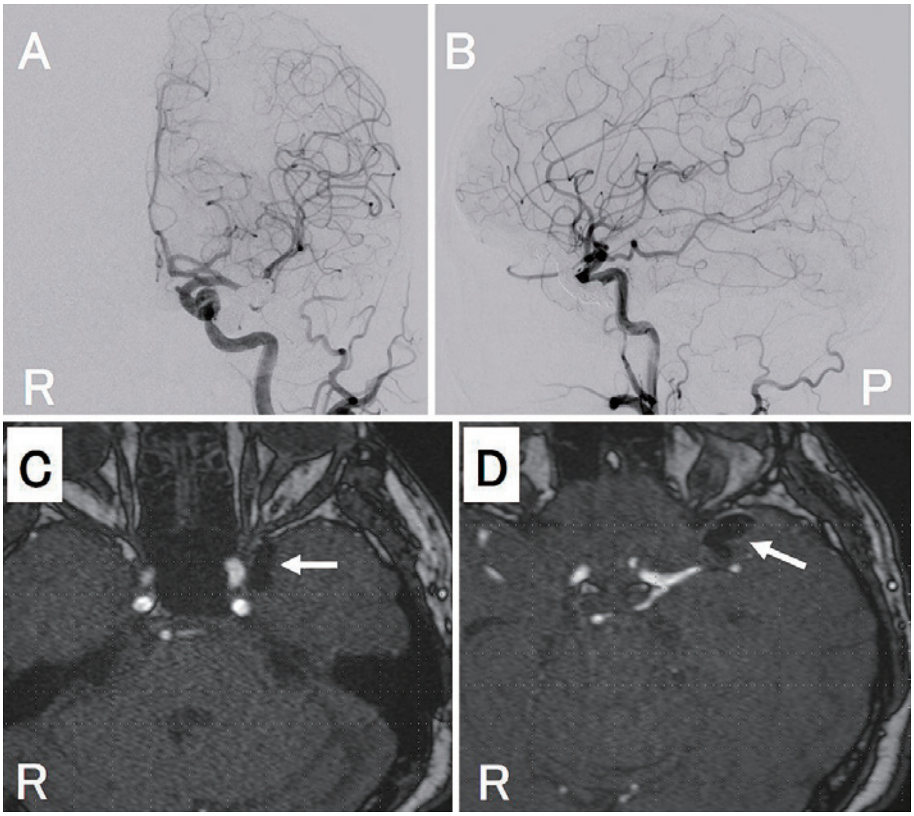

Fig. 4 Postoperative images.
R indicates the right. P indicates the posterior. A: Anterior–posterior view of the left common carotid angiography. B: Lateral view of the left common carotid angiography showing complete obliteration of the fistula. C, D: Magnetic resonance images showing the coil mass in the lateral cavernous sinus and affected veins (white arrows).

References

1) Hou K, Li G, Luan T, et al.: Endovascular treatment of the cavernous sinus dural arteriovenous fistula: current status and considerations. *Int J Med Sci* 17: 1121-1130, 2020
2) Korkmazer B, Kocak B, Tureci E, et al.: Endovascular treatment of carotid cavernous sinus fistula: a systematic review. *World J Radiol* 5: 143-155, 2013
3) Benndorf G, Bender A, Lehmann R, Lanksch W: Transvenous occlusion of dural cavernous sinus fistulas through the thrombosed inferior petrosal sinus: report of four cases and review of the literature. *Surg Neurol* 54: 42-54, 2000
4) Goldberg RA, Goldey SH, Duckwiler G, Vinuela F: Management of cavernous sinus-dural fistulas. Indications and techniques for primary embolization via the superior ophthalmic vein. *Arch Ophthalmol* 114: 707-714, 1996
5) Schmidbauer JM, Voges M, Schwerdtfeger K, Ruprecht KW: Embolization of dural carotid sinus fistulas via the sylvian vein in 2 patients. *Ophthalmologe* 98: 766-770, 2001
6) Borden JA, Wu JK, Shucart WA: A proposed classification for spinal and cranial dural arteriovenous fistulous malformations and implications for treatment. *J Neurosurg* 82: 166-179, 1995
7) Cognard C, Gobin YP, Pierot L, et al.: Cerebral dural arteriovenous fistulas: clinical and angiographic correlation with a revised classification of venous drainage. *Radiology* 194: 671-680, 1995
8) Lell M, Fellner C, Baum U, et al.: Evaluation of carotid artery stenosis with multisection CT and MR imaging: influence of imaging modality and postprocessing. *AJNR Am J Neuroradiol* 28: 104-110, 2007
9) Bucek RA, Puchner S, Kanitsar A, et al.: Automated CTA quantification of internal carotid artery stenosis: a pilot trial. *J Endovasc Ther* 14: 70-76, 2007
10) Tokunaga K, Barath K, Martin JB, Rüfenacht DA: Transarterial approach for selective intravenous coil embolization of a benign dural arteriovenous fistula: case report. *J Neurosurg* 99: 775-778, 2003
11) Takegami T, Imai K, Umezawa K, et al.: A case of the cavernous sinus dural arteriovenous fistula successfully treated with selective transarterial embolization of the fistulaus point using platinum coils. *J Neuroendovasc Ther* 6: 51-55, 2012 (Japanese)
12) Yamauchi T, Koguchi Y, Matsuura I, et al.: Transarterial embolization with coils via accessory meningeal artery for the cavernous sinus dural arteriovenous fistula: a case report. *J Neuroendovasc Ther* 9: 31-36, 2015 (Japanese)

Corresponding author: Tomotaka Ohshima, MD, PhD
Neuroendovascular Therapy Center, Aichi Medical University, 1-1 Yazakokarimata, Nagakute, Aichi 480-1195, Japan.
e-mail: tmtkoh@gmail.com