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SNI: Neurovascular

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Case Report

Spontaneous resolution of a tentorial dural arteriovenous fistula fed by the artery of Wollschlaeger and Wollschlaeger after embolization of the main shunting point

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Received : 19 June 2021
Accepted : 20 July 2021
Published : 16 August 2021

DOI
10.25259/SNI_610_2021

Quick Response Code:

ABSTRACT

Background: Tentorial dural arteriovenous fistula (TDAVF) is a rare intracranial vascular shunt. A TDAVF can be supplied by the Artery of Wollschlaeger and Wollschlaeger (AWW). However, a limited number of cases of TDAVF fed by the AWW have been reported to date.

Case Description: A 70-year-old woman complaining of the right motor weakness underwent magnetic resonance imaging. A vascular lesion beneath the cerebellar tentorium was incidentally found with chronic infarction of the left corona radiata. Angiographically, the vascular lesion was a TDAVF supplied by the bilateral posterior meningeal arteries. No other apparent feeders were detected. The TDAVF had a shunting point on the inferior surface of the cerebellar tentorium with venous retrograde flow (Borden type III, Cognard type III). To prevent vascular events, endovascular embolization was performed using n-butyl-2-cyanoacrylate. Following embolization of the shunting point, a residual shunt fed by the AWW was identified. The shunt supplied by the AWW was not observed preoperatively. Follow-up angiography performed 1 week later revealed spontaneous disappearance of the residual shunt. The patient was followed-up in our outpatient clinic, and no recurrence of the TDAVF was confirmed postoperatively.

Conclusion: Detection of mild feeding from the AWW to a TDAVF can be elusive preoperatively. Following embolization of the main shunting point, residual shunting from the AWW can resolve spontaneously.

Keywords: Artery of Wollschlaeger and Wollschlaeger, Endovascular treatment, N-butyl-2-cyanoacrylate, Tentorial dural arteriovenous fistula

INTRODUCTION

Intracranial dural arteriovenous fistulas account for approximately 10–15% of intracranial arteriovenous malformations.[10] Tentorial dural arteriovenous fistula (TDAVF) is considered rare due to the 4–8.4% prevalence of intracranial dural arteriovenous fistula.[12] Hemorrhagic events can occur in 60–75% of cases of TDAVF.[11] Endovascular treatment can be used to prevent strokes from TDAVF.[5] The aim of endovascular treatment for TDAVF is to completely

disconnect the shunting point.[5] The TDAVF can be supplied by the tentorial branches of the internal carotid artery, external carotid artery, and vertebral artery.[3] The Artery of Wollschlaeger and Wollschlaeger (AWW), a dural artery of the superior cerebellar artery (SCA), can also be a feeding artery for TDAVF. However, a TDAVF fed by the AWW has not been well described to date.[7]

Herein, we present a rare case of TDAVF fed by the AWW recognized after endovascular embolization of the main shunting point fed by the bilateral posterior meningeal arteries (PMAs).

CASE PRESENTATION

A 70-year-old woman presented to our outpatient clinic. She complained of motor weakness in the right hemisphere, which had appeared 4 months before. Magnetic resonance imaging was performed to rule out the presence of any intracranial lesions. Chronic lacunae infraction of the left corona radiata was detected on fluid-attenuated inversion recovery images. The lacunae infraction of the left corona radiata was considered a cause of her right motor weakness. No edematous changes were found in the infratentorial or supratentorial regions. However, magnetic resonance angiography revealed a vascular lesion [Figure 1a]. Vascular lesions were also found below the cerebellar tentorium on constructive interference in steady-state images [Figure 1b]. Cerebral angiography was performed as an arteriovenous shunt was suspected. A right external cerebral angiogram showed an arteriovenous shunt supplied by the mastoid branch of the occipital artery. A selective angiogram of the mastoid branch of the occipital artery revealed that the arteriovenous shunt was fed by the PMA. The arteriovenous shunt showed two draining patterns, travelling through the superior vermian vein to the petrosal vein and superior petrosal sinus and through the inferior hemispheric vein, inferior hemispheric vein, and tentorial sinus [Figure 2a and b]. The left occipital angiogram showed an arteriovenous shunt fed by the left PMA [Figure 2c and d]. On maximum intensity projection images, the shunting point was located beneath the cerebellar tentorium, and the drainer ran through the tentorial sinus into the transverse sinus [Figure 2e]. The internal carotid angiogram revealed no apparent feeders. The bilateral posterior cerebral arteries were of a fetal type. The straight sinus flow was anterograde. The left vertebral angiogram revealed no feeders. Venous congestion was suspected on the venous phase of the left vertebral angiogram. No retrograde flow of the basal vein of Rosenthal was observed [Figure 2f-i]. Based on the findings of cerebral angiography, the arteriovenous shunt was diagnosed as TDAVF fed by the bilateral PMAs draining into the straight sinus with retrograde venous flow (Borden type III, Cognard type III). Transarterial endovascular surgery was planned to prevent hemorrhagic events associated with TDAVF.[4]

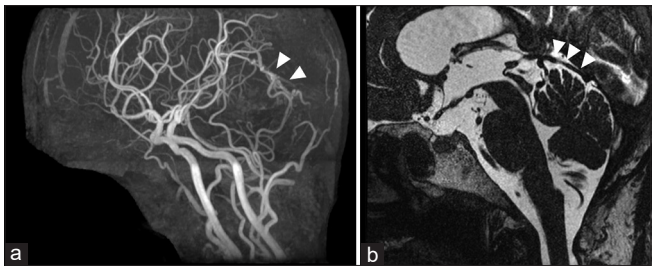

Figure 1: Preoperative magnetic resonance images. (a) A vascular lesion is suspected on magnetic resonance angiography (white arrow heads). (b) The vascular lesion is located beneath the cerebellar tentorium (white arrow heads).

Endovascular surgery

Under general anesthesia, two Envoy 5F 90 cm MPD (Codman Neuro, Raynham, MA, USA) were introduced in the bilateral occipital artery. The mastoid branch of the left occipital artery was selected with a Masters HF 2.8-Fr/3.2-Fr 125 cm (ASAHI INTECC J-Sales, CO., LTD, Tokyo, Japan) and a Traxcess 14 0.012/0.014 200 cm (Terumo Corporation, Tokyo, Japan). The Masters HF 2.8-Fr/3.2-Fr 125 cm was placed at the mastoid foramen. Using an ASAHI CHIKAI 0.014 200 cm (ASAHI INTECC J-Sales, CO., LTD, Tokyo, Japan) and a Traxcess 14 0.012/0.014 200 cm, another Masters HF 2.8-Fr/3.2-Fr 125 cm was introduced through the mastoid branch of the right occipital artery to the right PMA. As the left PMA was quite tortuous compared to the right PMA, we considered that a transarterial embolization approached from the right PMA was the easiest course of action. From the right Masters HF 2.8-Fr/3.2-Fr 125 cm, a Carnelian MARVEL® 1.6/1.8-Fr 155 cm (Tokai Medical Products Inc.) was introduced near the shunting point with an ASAHI CHIKAI 0.008 200 cm (ASAHI INTECC J-Sales, CO., LTD, Tokyo, Japan) [Figure 3a]. A Carnelian MARVEL® 1.6/1.8-Fr 155 cm was also placed in the left PMA to inject the contrast medium intraoperatively. The inner lumen of the right Carnelian MARVEL® 1.6/1.8-Fr 155 cm was filled with 5% glucose solution, after which heated 20% n-butyl-2-cyanoacrylate (NBCA) was injected from the right Carnelian MARVEL® 1.6/1.8-Fr 155 cm. After NBCA reached the drainer with an injection volume of 0.3 mL, the right Carnelian MARVEL® 1.6/1.8-Fr 155 cm was removed. NBCA migrated partially to the left transverse sinus, left inferior hemispheric vein, and left petrosal vein [Figure 3b and c]. The right and left occipital angiogram revealed the disappearance of the shunt [Figure 3d-g], which was also confirmed by cone beam computed tomography using a half-diluted contrast agent. NBCA did not migrate to the arteries. The bilateral common carotid angiogram also revealed the disappearance of the shunt, and the venous

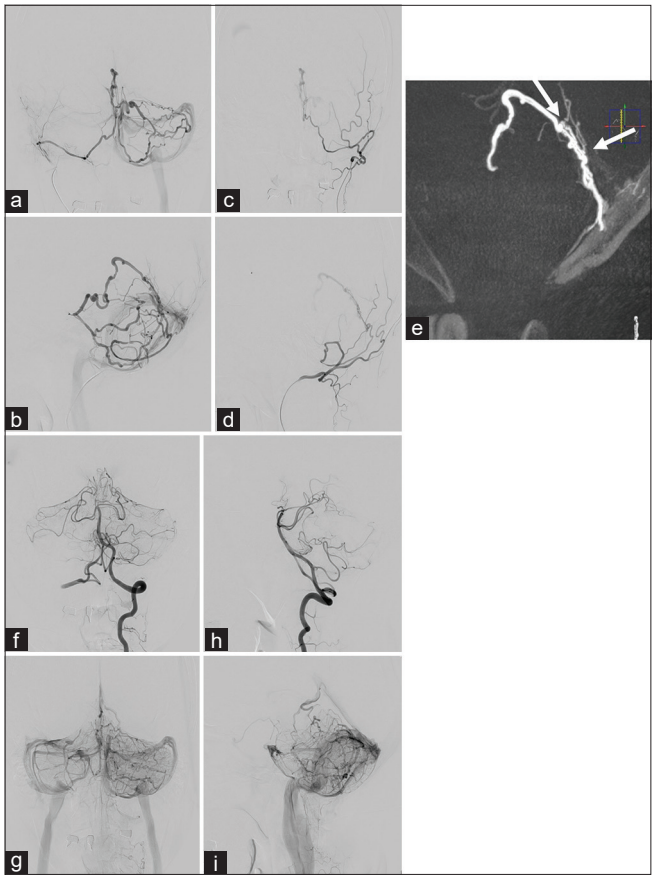

Figure 2: Preoperative angiographic findings. Selective angiogram of the right mastoid branch of the occipital artery demonstrating an arteriovenous shunt fed by the right PMA. The shunt shows two drainage pathways, running through the superior vermian vein to the petrosal vein terminating to the transvers sinus and through the superior vermian vein to the inferior vermian vein terminating to the tentorial sinus (a: anteroposterior projection and b: lateral projection). A left occipital angiogram reveals that the arteriovenous shunt is also supplied by the left PMA (c: anteroposterior projection and d: lateral projection). The shunting point is located beneath the cerebellar tentorium (white arrows: caliber change) (e). A left vertebral angiogram does not reveal any apparent feeding arteries. Venous congestion of the left vermian hemisphere is observed. The venous circulation is antegrade but stagnated. (f) Arterial phase of anteroposterior projection. (g) Venous phase of anteroposterior projection (h) arterial phase of lateral projection. (i) Venous phase of lateral projection. PMA: Posterior meningeal artery.

flow was anterograde. A vertebral angiogram was finally acquired to ensure shunt disappearance. However, a residual arteriovenous shunt, which was not seen on preoperative angiography, was identified. Venous congestion also remained in the left cerebellar hemisphere [Figure 3h-j]. On 3-dimensional reconstructed maximum intensity projection (3D-MIP) images, the residual arteriovenous shunt beneath the cerebellar tentorium was identified above the location of the NBCA along the cerebellar tentorium [Figure 3k]. On the 3D-MIP images, a dural branch originating from the SCA was identified as the feeder of the residual shunt. The artery originated close to the bifurcation of the basilar artery and the SCA. The artery branched from the anterior pontomesencephalic segment of the SCA and was considered to be the AWW [Figure 3l and m]. As the embolization of the main shunting point with NBCA was successfully achieved and the shunting flow was not remarkably strong, we considered that the residual arteriovenous shunt could be monitored under observation.

Postoperative course

The patient's postoperative course was uneventful. The residual arteriovenous fistula fed by the AWW disappeared spontaneously, as seen on follow-up vertebral angiography 1 week after the procedure [Figure 4a and b]. No cerebellar ischemic lesion was observed postoperatively. The patient was discharged from the hospital without any neurological deficits. No apparent recurrence of the TDAVF was observed on the cerebral angiogram acquired 6 months after endovascular embolization.

DISCUSSION

Here, we present a relatively rare case of TDAVF fed by bilateral PMAs and AWW. Our case showed that the arterial supply from AWW to TDAVF was not visualized preoperatively. However, the arterial supply from the AWW to TDAVF was clearly observed after the bilateral PMAs were embolized with NBCA. In addition, the residual shunt fed by the AWW disappeared spontaneously without a second surgical treatment.

The following arteries supplying the cerebellar tentorium can feed a TDAVF: the meningeal branches of the internal carotid artery (meningohypophyseal trunk), external carotid artery (ascending pharyngeal artery, occipital artery, and middle meningeal artery), posterior cerebellar artery (artery of Davidoff and Schechter), and vertebral artery (PMA).[7] The feeding artery of the cerebellar tentorium can originate from the SCA and also feed the TDAVF.[3,7] The tentorial branch originating from the SCA has been described using various names, such as the meningeal artery, tentorial artery, or medial dural-tentorial branch of the SCA.[3] Later, the medial dural-tentorial branch of the SCA was named the AWW[6,9] because this artery was reported in 1965 by Wollschlaeger and Wollschlaeger.[13] The AWW usually originates from the rostral trunk of the SCA in the lateral mesencephalic segment and runs under the tentorium.[2,3] In our case, the origin of the artery supplying the residual shunt was located in the anterior pontomesencephalic segment of the SCA, which does not correspond to the typical origin of the AWW. However, after the spontaneous disappearance of the residual

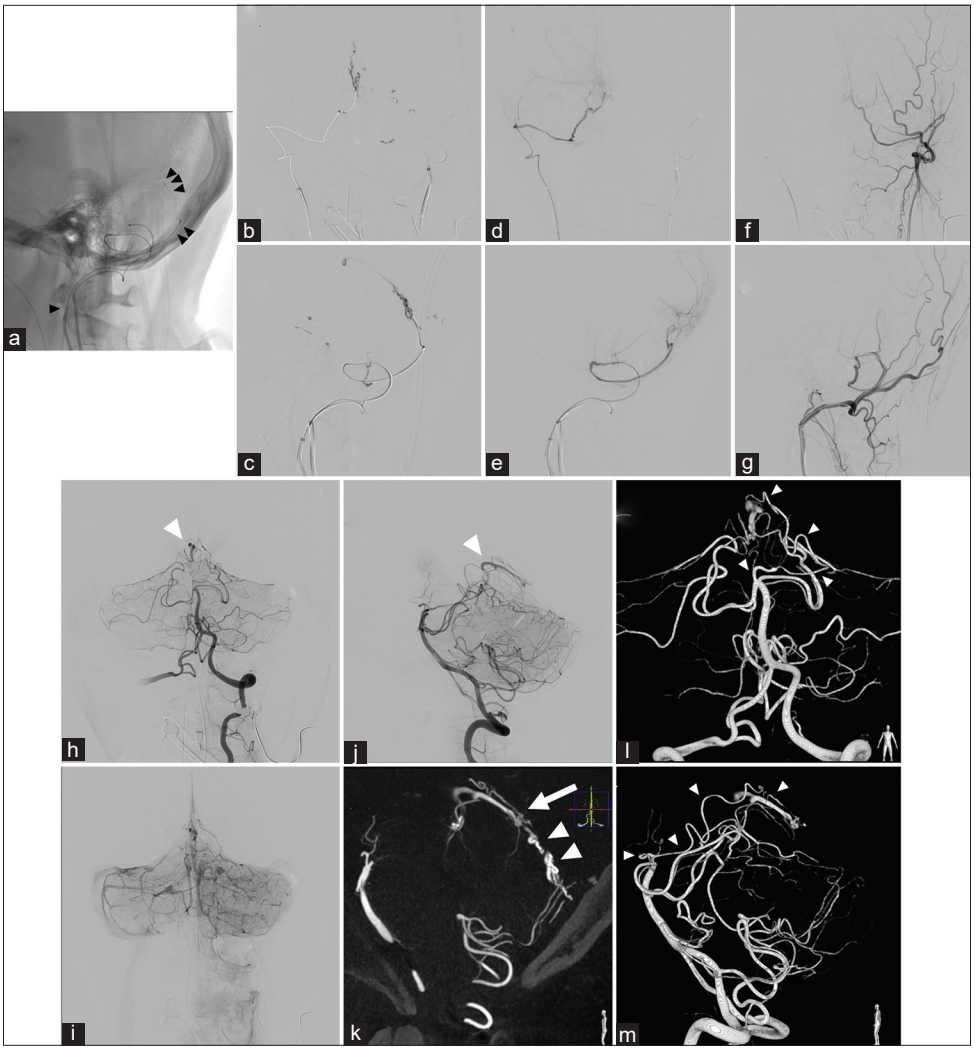

Figure 3: Intraoperative angiographic findings. Endovascular devices were introduced near to the shunting point (single black arrowhead: Envoy 5F 90 cm MPD, double black arrow heads: Masters HF 2.8-Fr/3.2-Fr 125 cm and triple black arrow heads: Carnelian MARVEL® 1.6/1.8-Fr 155 cm) (a: lateral projection). The shunting point was embolized with 20% of NBCA. NBCA was partially migrated (b: anteroposterior injection and c: lateral projection). After the injection of 20% NBCA, the arteriovenous shunt was not seen. (d) Anteroposterior projection of the right occipital angiogram. (e) Lateral projection of the right occipital angiogram. (f) Anteroposterior projection of the left occipital angiogram. (g) Lateral projection of the left occipital angiogram. The left vertebral angiogram shows the residual arteriovenous shunt (white arrowhead). Venous congestion remained (h: arterial phase of anteroposterior projection, i: venous phase of anteroposterior projection, and j: arterial phase of lateral projection). The residual shunting point is located beneath the cerebellar tentorium (white arrow). The shunting point embolized with 20% of NBCA is also recognized (white arrow heads) (k: a sagittal image of maximum intensity projection). The residual arteriovenous shunt is supplied by the AWW (white arrow heads). The AWW branched near the bifurcation of the basilar artery and superior cerebellar artery (l and m: three-dimensional images). AWW: The artery of Wollschlaeger and Wollschlaeger, NBCA: n-butyl-2-cyanoacrylate.

shunt, no ischemic lesion of the cerebellum was observed. We speculate that the artery supplying the residual shunt was a dural branch of the SCA. Thus, we considered that the artery supplying the residual shunt was the AWW. Clinically, it is important to not confuse the AWW for the artery of Davidoff and Schechter. However, the artery of Davidoff and Shechter usually runs above the cerebellar tentorium.[3] In our case, the bilateral posterior cerebral arteries were of the fetal type. Thus, the artery feeding the residual shunt was not the artery of Davidoff and Schechter.

The arterial supply to the cerebellar tentorium by SCA is inconsistent and frequently overlooked.[7] The contributions of the SCA to TDAVF seem rare.[1,3,7,8,14] However, to evaluate arterial supply to TDAVF, especially when the TDAVF is located in the midline of the tentorium, selective

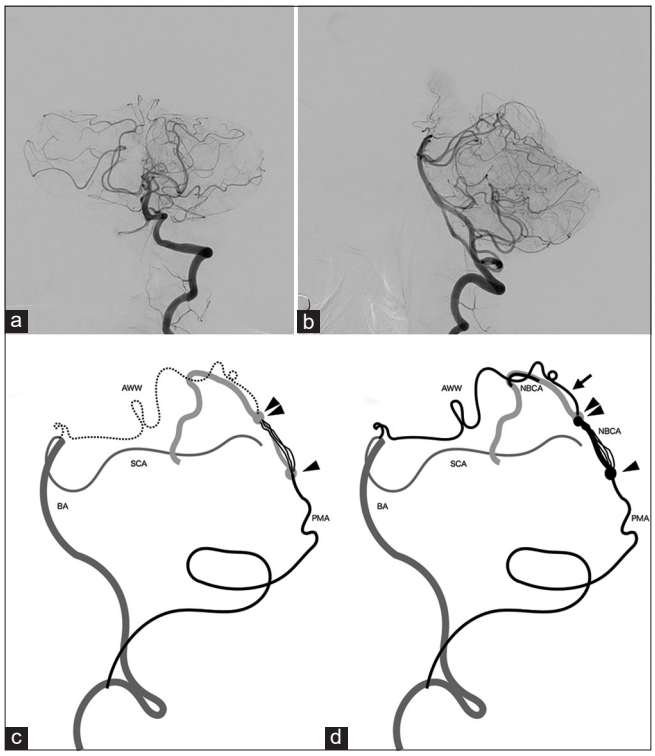

Figure 4: Postoperative angiography and schemas of the TDAVF in this case. (a and b) Left vertebral angiogram performed 1 week after the endovascular surgery reveals no residual arteriovenous shunt. (c and d) Schemas of the arterial supply and shunting point of the TDAVF. Preoperatively, the arterial feeding by AWW was not visualized (c). Postoperatively, the arterial feeding by AWW is observed (arrow). The shunting point was embolized with NBCA (the region margined with arrow heads). AWW: The artery of Wollschlaeger and Wollschlaeger, BA: The basilar artery, NBCA: n-butyl-2-cyanoacrylate, PMA: The posterior meningeal artery, SCA: The superior cerebellar artery.

angiography of the SCA is reported to be mandatory.[3] Byrne and Garcia described a case of TDAVF fed by AWW that was successfully diagnosed by selective angiography of SCA.[3] In their case, the blood supply by AWW was identified distal to the bifurcation of the basilar artery and SCA.[3] Selective angiography of the SCA could be an option in our case. However, in our case, the AWW branched near the bifurcation of the basilar artery and the SCA. Thus, it remains unknown whether selective angiography of the SCA in our case could be effective.

In the present case, the residual shunt fed by the AWW resolved spontaneously after the shunting point was embolized with NBCA. This is possibly because the shunting point between the bilateral PMAs and the tentorial sinus was the main pathological factor. Subsequently, the residual shunt could have been thrombosed. This speculation seems coherent with preoperative angiographic findings in that the arterial supply by the bilateral PMAs was visualized while no arterial supply by the AWW was observed [Figure 4c and d].

CONCLUSION

Here, we present a rare case of TDAVF supplied by bilateral PMAs and AWW. Mild supply to the TDAVF can be visualized after the major shunting point is embolized. Surgeons should always be aware of this possibility and should assess the necessity of additional embolization of the residual arterial supply by AWW. Postoperative angiographical follow-up can be sufficient in cases in which the flow of the residual shunt is low.

Declaration of patient consent

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

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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How to cite this article: Ishibashi R, Maki Y, Ikeda H, Chin M. Spontaneous resolution of a tentorial dural arteriovenous fistula fed by the artery of Wollschlaeger and Wollschlaeger after embolization of the main shunting point. Surg Neurol Int 2021;12:413.