ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

www.surgicalneurologyint.com

Surgical Neurology International

Editor-in-Chief: Nancy E. Epstein, MD, Clinical Professor of Neurological Surgery, School of Medicine, State U. of NY at Stony Brook.

SNI: Neurovascular

Editor
Kazuhiro Hongo, M.D.,
Shinshu University, Matsumoto, Japan

SNI
Open Access

Case Report

Transfemoral transvenous embolization through the vein of Trolard and superficial middle cerebral vein for cavernous sinus dural arteriovenous fistula with isolated cortical vein drainage: A case report and literature review

Prasert Iampreechakul[1], Korrapakc Wangtanaphat[1], Sunisa Hangsapruek[2], Yodkhwan Wattanasen[2], Punjama Lertbutsayanukul[2], Somkiet Siriwimonmas[3]

Departments of [1]Neurosurgery and [2]Neuroradiology, Prasat Neurological Institute, [3]Department of Radiology, Bumrungrad International Hospital, Bangkok, Thailand.

E-mail: Prasert Iampreechakul - bangruad@hotmail.com; Korrapakc Wangtanaphat - win0000000@gmail.com; Sunisa Hangsapruek - hsunisa@gmail.com; Yodkhwan Wattanasen - slainooo@hotmail.com; Punjama Lertbutsayanukul - lpunjama@hotmail.com; Somkiet Siriwimonmas - somkietsiri@hotmail.com

***Corresponding author:**
Prasert Iampreechakul,
Department of Neurosurgery,
Prasat Neurological Institute,
Bangkok, Thailand.

bangruad@hotmail.com

Received : 21 November 2021
Accepted : 07 January 2022
Published : 29 January 2022

DOI
10.25259/SNI_1162_2021

Quick Response Code:

ABSTRACT

Background: Endovascular treatment may be challenging for cavernous sinus dural arteriovenous fistulas (CSDAVFs) with prominent leptomeningeal drainage without other accessible routes. We report a case of CSDAVF with isolated cortical venous successfully drainage treated by percutaneous transvenous embolization through the vein of Trolard and superficial middle cerebral vein (SMCV). We also review the literature of CSDAVFs treated by transvenous embolization through SMCV with or without combined surgical approach.

Case Description: A 46-year-old woman presented with ocular symptoms and delayed treatment was encountered due to the COVID-19 pandemic. Cerebral angiography showed a CSDAVF (Barrow type D, Borden II, and Cognard II a + b) with isolated cortical vein drainage. Percutaneous transvenous access to the fistula through the inferior petrosal sinus was attempted but failed. Transvenous embolization through the vein of Trolard and SMCV was further attempted, and satisfactory occlusion of the fistula was achieved with detachable coils. This access route was chosen because of the occlusion of other access routes and can obliterate the need for more invasive approach, that is, combined surgical and endovascular approach. Cerebral angiography obtained 6 months following the procedure, confirmed complete angiographic obliteration of the fistula. The patient made an uneventful recovery.

Conclusion: To avoid invasive combined surgical and endovascular approach, transvenous embolization through the vein of Trolard and SMCV may be another accessible option for treating CSDAVF with isolated cortical venous drainage.

Keywords: Cavernous sinus dural arteriovenous fistula, Indirect carotid-cavernous fistula, Superficial middle cerebral vein, The vein of Trolard, Transvenous embolization

INTRODUCTION

Cavernous sinus dural arteriovenous fistulas (CSDAVFs) are abnormal communications between dural arteries and the cavernous sinus (CS). Feeding vessels may arise from dural branches of the

cavernous segment of the internal carotid artery, that is, the meningohypophyseal trunk and/or inferolateral trunk, and/or the external carotid artery, that is, the middle meningeal artery, accessory meningeal artery, artery of foramen rotundum, and/or ascending pharyngeal artery. CSDAVFs commonly appear in middle-aged female and symptoms of the patients usually relate to venous drainage patterns of the CS.[14,15]

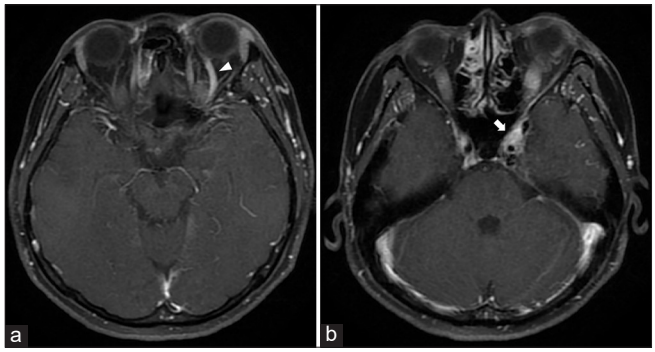

Figure 1: (a and b) Axial T1-weighted fat-saturated gadolinium-enhanced magnetic resonance images of the brain show enlarged left superior ophthalmic vein (arrowhead) and cavernous sinus (arrow).

Due to the risk of embolic complications associated with transarterial embolization of CSDAVFs, transvenous approach through the inferior petrosal sinus (IPS) using coils and/or liquid embolic materials was preferred method.[4,5] Patients harboring CSDAVFs with prominent cortical venous drainage are indicated for aggressive treatment due to the associated risk of intracerebral hemorrhage. However, transfemoral transvenous embolization for these fistulas draining only into the superficial middle cerebral vein (SMCV) may be infeasible and transcortical vein approach using a combined surgical and endovascular technique is required to access the affected CS.[1]

We present a challenging case of transvenous embolization through the vein of Trolard and SMCV for CSDAVF with

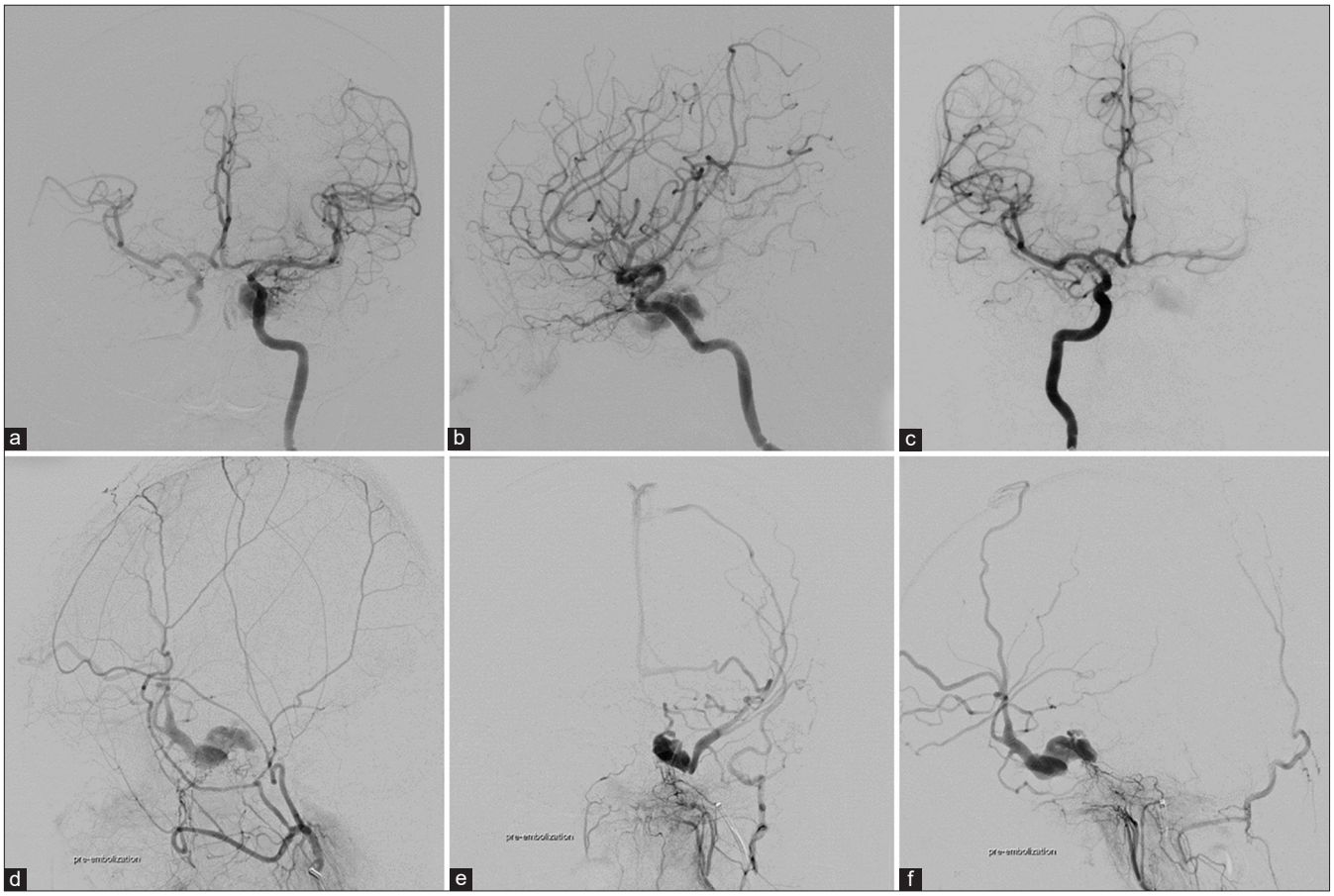

Figure 2: (a) Anteroposterior (AP) and (b) lateral views of the left internal carotid artery (ICA) angiography show the left cavernous sinus dural arteriovenous fistula supplied from the left meningohypophyseal trunk (MHT). (c) AP view of the right ICA injection demonstrates the clival branch from the right MHT supplying the fistula. (d) Lateral view of the external carotid artery injection reveals the same fistula fed by the artery of the foramen rotundum and accessory meningeal artery. (e) AP and (f) lateral views of the left ascending pharyngeal artery injection illustrate the arterial feeders supplying the fistula with retrograde venous drainage into the left sphenoparietal sinus, superficial middle cerebral vein, the basal vein of Rosenthal, and multiple frontal and parietal cortical veins.

isolated cortical venous drainage by a femoral venous approach. We also review the literature of patients treated by transvenous embolization for CSDAVFs through SMCV.

CASE DESCRIPTION

A 46-year-old woman experienced left red eye, proptosis, and diplopia for 2 weeks. She went to a local hospital and was found to have a left sixth cranial nerve paresis. Cranial magnetic resonance imaging revealed the dilatation of the left superior ophthalmic vein (SOV) and enlarged left CS [Figure 1]. The diagnosis of CSDAVF was suspected and the patient was referred to our institute for further investigation and management. At that moment, she could not come to our institute due to the COVID-19 pandemic. Three months later, she noted that her left eye became redder and more protrusion for 1 week. Later, her ocular symptoms gradually resolved. Four months later after the easing of lockdown, the patient came to our institute. On ophthalmic examination, the left eye had no proptosis, mild lateral rectus paresis, and normal intraocular pressure. Visual acuity was 20/20 in both eyes. The remaining neurological examination was normal. One week later, cerebral angiography was performed and showed the left CSDAVF (Barrow type D, Borden II, and Cognard II a+b) supplied by multiple dural branches of both cavernous internal carotid arteries (i.e., meningohypophyseal trunk), left external carotid artery (i.e., the artery of the foramen rotundum and accessory meningeal artery), and left ascending pharyngeal artery with retrograde venous drainage primarily into multiple left frontal and parietal cortical veins including the vein of Trolard through the left sphenoparietal sinus and SMCV. In addition, the fistula drained into the left the basal vein of Rosenthal, the great vein of Galen, and the straight sinus. The SOV, IPS, and pterygoid plexus were not visualized on angiography, even in the late venous phase [Figure 2]. To prevent intracranial hemorrhage from cortical venous reflux, the patient was advised to treat this fistula with endovascular treatment as a first choice.

Under general anesthesia, transvenous embolization through the occluded left IPS was attempted but failed to reach the CS. We decided to try to access the left vein of Trolard. With heparinization, distal access guiding catheter (Fargo MAX, Balt Extrusion, Montmorency, France) was introduced into the left sigmoid sinus. Under fluoroscopic road map, Prowler Plus (Codman Neurovascular, Raynham, MA, USA) microcatheter, length 150 cm, was used over the Agility Steerable guidewire (0.016 soft, Codman Neurovascular, Raynham, MA, USA) but this microcatheter was too short to navigate into the CS. Therefore, the microcatheter was changed to Prowler Select Plus (Codman Neurovascular, Raynham, MA, USA), length 170 cm, over the same guidewire. This system was successfully navigated into the affected CS [Figures 3a and b]. The first detachable fibered coils (Interlock-35, Boston Scientific, Natick, MA) were used but infeasible to insert into the CS because the length of this fibered occlusion system was not enough to reach the target. Then, we used Axium Detachable coil (Medtronic, Minneapolis, Minnesota, USA) instead of a fibered coil. After packing of nine Axium coils, control angiography revealed significant reduction of the shunt flow and venous stasis [Figures 3c and d]. Postembolization course of the patient was uneventful. Cerebral angiography, obtained 6 months after embolization, confirmed complete obliteration of the CSDAVF [Figure 4]. Her ocular symptoms had completely resolved.

DISCUSSION

The access route for transvenous embolization of CSDAVFs depends on the patency of the accessible drainage pathways of the CS.[17] The vast majority of CSDAVFs were treated by transvenous embolization through IPS as the first-line therapy. Using the transfemoral venous approach, several other access routes to the CS have been described, including SOV through a facial vein or superficial middle temporal, contralateral CS, superior petrosal sinus, and pterygoid venous plexus.[11,18] Endovascular treatment through direct cannulation into SOV directly or indirectly through the

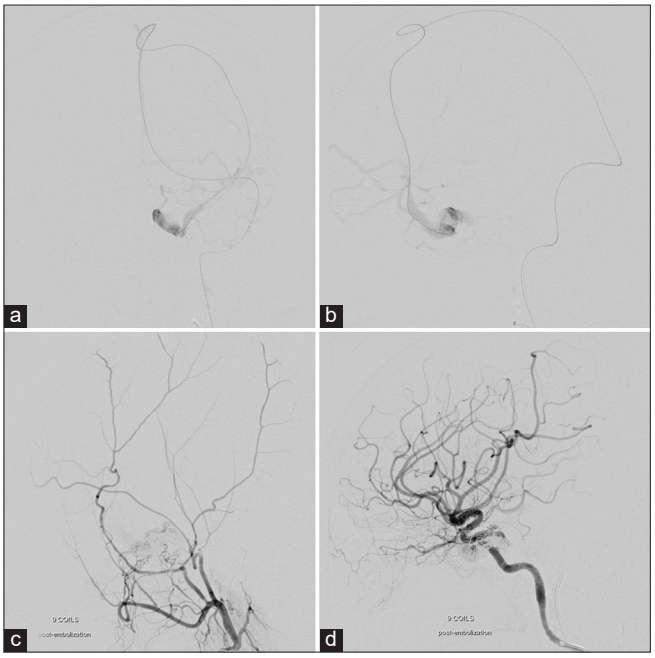

Figure 3: (a) Anteroposterior and (b) lateral views of venography revealed the affected cavernous sinus after successful navigation of the tip of the microcatheter into the cavernous sinus through the left vein of Trolard and superficial middle cerebral vein. Lateral views of the (c) external and (d) internal carotid arteries injections following the embolization with coils demonstrate significant reduction of the shunt flow.

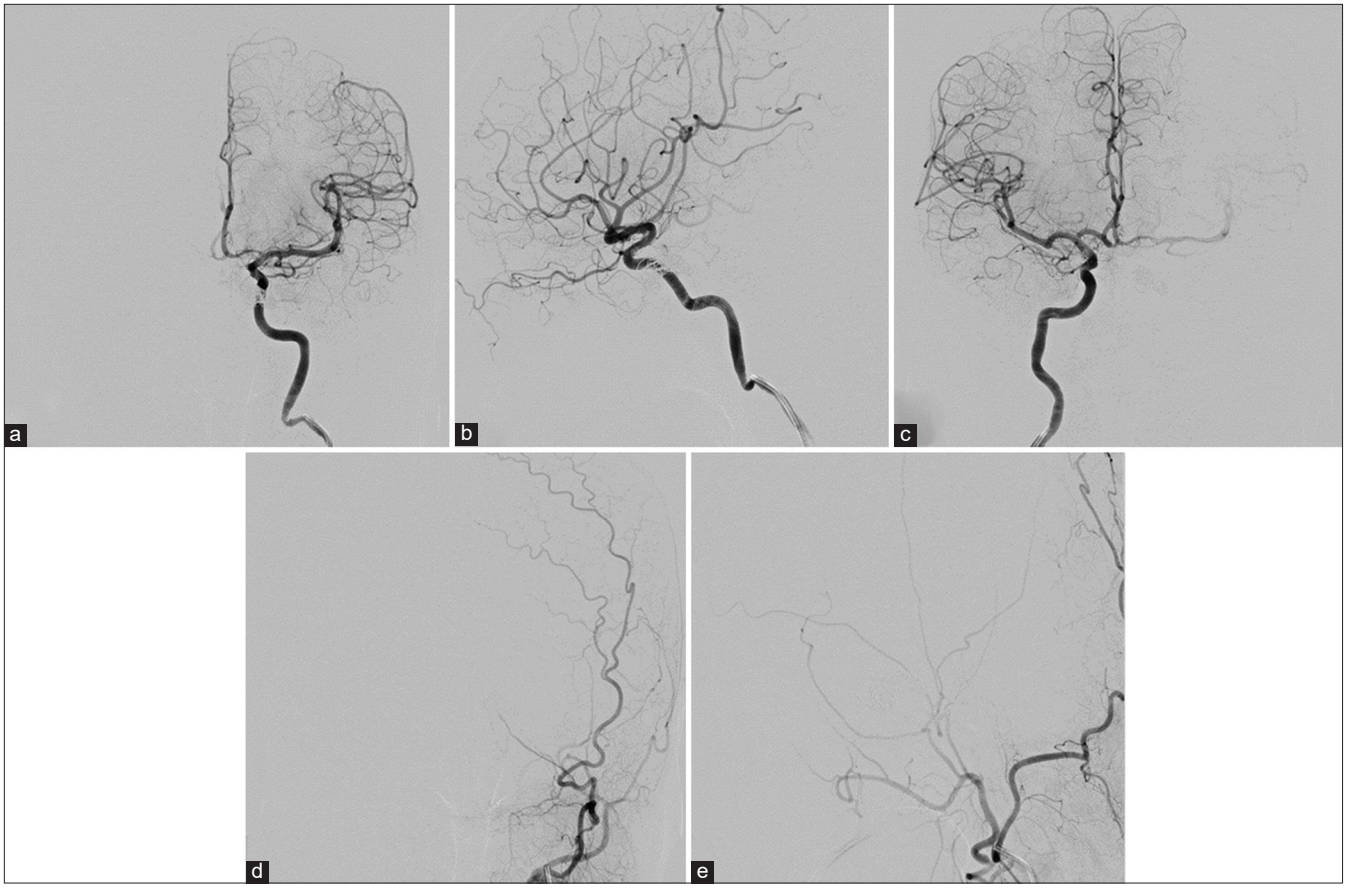

Figure 4: Cerebral angiography obtained 6 months after embolization. (a) Anteroposterior (AP) and (b) lateral views of the left internal carotid artery (ICA), (c) AP view of the right ICA, and (d) AP and (e) lateral views of the left external carotid artery confirm complete obliteration of the cavernous sinus arteriovenous fistula.

facial vein may be another option.[13,19] Despite the absence or occlusion of IPS, the experienced neurointerventionist preferred to use this route as the first choice for transvenous embolization of CSDAVFs.[8,9] A combined surgical and endovascular access to obliterate CSDAVFs should be considered as a final option.[6]

In our case, percutaneous transvenous access to the fistula through IPS was attempted but failed. Without other accessible routes, we decided to access the fistula through the superficial cerebral vein which its diameter was quite large enough to advance the microcatheter. However, we considered more invasive transcranial transcortical venous approach in case of unsuccessful attempt of percutaneous transvenous access through the cortical vein.

The vein of Trolard, superior anastomotic vein, is the largest superficial vein crossing the cortical surface of the frontal and parietal lobes between the superior sagittal sinus and SMCV.[16] To the best of our knowledge, our case is the first case report of transvenous embolization through the vein of Trolard and SMCV for CSDAVF with isolated cortical venous drainage by a femoral venous approach. Similarly, Konstas *et al*.[10] reported successful percutaneous embolization of CSDAVF through the vein of Labbé, inferior anastomotic vein crossing the temporal lobe between the transverse sinus and SMCV.

We reviewed the published studies in English language with sufficient information about CSDAVFs treated with transvenous embolization through SMCV [Table 1]. The collected data in this review include demographic data (i.e., gender and age of patient), symptoms and signs, side of fistula, type of fistula according to the Barrow classification, venous drainage of fistula, the treatment, and neurological outcome after treatment. From the literature review, there were eight cases including our one case (seven females and one male) with a median age of 64.5 years (range 46–84 years).[1-3,6,10,12,17] All patients initially presented with ocular symptoms and subsequent thrombosis of SOV occurred. About 50% of patients developed intracerebral hemorrhage. The fistulas were right sided in 4 patients (50%) and left sided in 4 (50%). Out of eight cases, 2 (25%) were type C Barrow classification and 6 (75%) were type D. All patients but one, the CSDAVFs drained mainly toward ipsilateral SMCV. Before using superficial cerebral vein route, most patients were attempted

Table 1: Literature review of patients with CSDAVFs treated with transvenous embolization through superficial middle cerebral vein.

Authors	Gender/ Age	Symptoms and signs	Side/type of the fistula	Venous drainage	Treatment	Neurological outcome
Kuwayama *et al.* (1998)[12]	M/48	A 2-year history of bilateral tinnitus and sudden onset of headache and Lt. hemiparesis/ ICH	Rt./D	RT. SpPS and SMCV	• Failed IPS approach. • Craniotomy and TVE through SMCV with coils	IR
Hurley *et al.* (2011)[6]	F/75	A 3-month history of the left retro-orbital headache, 1 week of intermittent diplopia, and several days of worsening slurred speech/Small ICH	Lt./D	Lt. SMCV	• TAE with Onyx. • Craniotomy and TVE through SMCV with coils	GR
Chaudhary *et al.* (2012)[2]	F/82	Diplopia, Lt. sixth cranial nerve palsy, intraocular hypertension, and bilateral chemosis	Lt./D	Lt. SpPS and SMCV	• Failed IPS approach. • TAE with NBCA. • Craniotomy and TVE through SMCV with coils	GR*
Akamatsu *et al.* (2017)[1]	F/84	A 5-month history of Rt. chemosis, intraocular hypertension. A sudden onset headache followed by deep coma and Lt. hemiparesis/ICH	Rt./C	Rt. SpPS and SMCV	Craniotomy with removal of blood clot and TVE through SMCV with coils	IR
Konstas *et al.* (2018)[10]	F/61	Lt. orbital proptosis, chemosis, headache, diplopia, and intraocular hypertension	Lt./D	Lt. SMCV	TVE through the vein of Labbé and SMCV with coils and Onyx	GR
Ghosh *et al.* (2020)[3]	F/48	Bilateral conjunctival injection, chemosis, periorbital pain, and diplopia	Rt./D	Rt. SMCV	• Failed IPS approach. • Burr hole under image guidance and TVE through SMCV with Onyx	GR
Sato *et al.* (2021)[17]	F/68	A 2-month history of Lt. chemosis and ptosis. Small ICH	Rt./C	ICS and Lt. SMCV	• Failed IPS approach. • Craniotomy and TVE through contralateral SMCV with coils in a hybrid operating room	GR
Present case	F/46	A 2-week history of left red eye, proptosis, diplopia, and sixth cranial nerve paresis. Delayed treatment due to the COVID-19 pandemic	Lt./D	Lt. SpPS and SMCV BVR	• Failed IPS approach. • TVE through the vein of Trolard, SMCV, and SpPS with coils	GR

BVR: The basal vein of Rosenthal; C: Type C Barrow classification; CSAVF: Cavernous sinus dural arteriovenous fistula; D: Type D Barrow classification; F: Female; GR: Good recovery; ICH: Intracerebral hemorrhage; ICS: Intercavernous sinus; IR: Incomplete recovery; Lt: Left; M: Male; NBCA: N-butyl cyanoacrylate; Rt: Right; SMCV: Superficial middle cerebral vein; SpPS: Sphenoparietal sinus; TAE: Transarterial embolization; TVE: Transvenous embolization; *: Partial recurrence at 18-month follow-up

with transvenous embolization through IPS approach or transarterial embolization with liquid embolic materials. Six (75%) patients were treated by combined surgical and endovascular access of the SMCV to occlude the fistula. Only 2 (25%), including our one case, were treated by transfemoral transvenous embolization through superficial cerebral veins, that is, the vein of Labbé and the vein of Trolard. The most patients had good neurological outcome after treatment except the patients who had large intracerebral hematoma. Only one patient had partial recurrence at an 18-month follow-up.

The technological advances in microcatheter design, embolic materials, and fluoroscopic imaging equipment permit access to the CS through multiple routes, making endovascular treatment becoming the preferred treatment modality for CSDAVFs. The endovascular approach should be adjusted to individual case based on the angioarchitecture or angiographic features of the fistula.[11] However, transvenous embolization of CS can be associated with various complications. Cranial nerve dysfunction was the most common complication following transvenous embolization.

The aggravation of preexisting cranial nerve symptoms or new cranial nerve dysfunction may cause by the overpacking of embolic materials in the CS.[4] In the present study, we preferred to packed coils until the presence of venous stasis within the CS occurred without overpacking. The presence of venous stasis in the CS may represent the thrombosis of the CS and this situation has a high tendency of further complete resolution of the fistula.[7] Follow-up cerebral angiography obtained 6 months following the procedure confirmed our speculation.

CONCLUSION

To avoid invasive combined surgical and endovascular approach, transvenous embolization through the vein of Trolard and SMCV may be another accessible option for treating CSDAVF with isolated cortical venous drainage.

Declaration of patient consent

Institutional Review Board (IRB) permission obtained for the study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Akamatsu Y, Sato K, Endo H, Matsumoto Y, Tominaga T. Single-session hematoma removal and transcranial coil embolization for a cavernous sinus dural arteriovenous fistula: A technical case report. World Neurosurg 2017;104:1046.e7-12.
2. Chaudhary N, Lownie SP, Bussière M, Pelz DM, Nicolle D. Transcortical venous approach for direct embolization of a cavernous sinus dural arteriovenous fistula: Technical case report. Neurosurgery 2012;70 Suppl 2:343-8.
3. Ghosh R, Al Saiegh F, Mahtabfar A, Mouchtouris N, Khanna O, Sweid A, *et al*. Burr hole-assisted direct transsylvian venous catheterization for carotid-cavernous fistula embolization: A case report. Oper Neurosurg (Hagerstown) 2020;19:E196-200.
4. Guo H, Yin Q, Liu P, Guan N, Huo X, Li Y. Focus on the target: Angiographic features of the fistulous point and prognosis of transvenous embolization of cavernous sinus dural arteriovenous fistula. Interv Neuroradiol 2018;24:197-205.
5. Halbach VV, Higashida RT, Hieshima GB, Hardin CW, Pribram H. Transvenous embolization of dural fistulas involving the cavernous sinus. AJNR Am J Neuroradiol 1989;10:377-83.
6. Hurley MC, Rahme RJ, Fishman AJ, Batjer HH, Bendok BR. Combined surgical and endovascular access of the superficial middle cerebral vein to occlude a high-grade cavernous dural arteriovenous fistula: Case report. Neurosurgery 2011;69:E475-81; discussion E481-2.
7. Iampreechakul P, Tirakotai W, Tanpun A, Wattanasen Y, Lertbusayanukul P, Siriwimonmas S. Spontaneous resolution of direct carotid-cavernous fistulas: Case series and literature review. Interv Neuroradiol 2019;25:71-89.
8. Iampreechakul P, Wangtanaphat K, Lertbutsayanukul P, Wattanasen Y, Siriwimonmas S. Spontaneous closure of a cavernous sinus dural arteriovenous fistula with spinal perimedullary drainage (Cognard V) during attempted transvenous embolization. Asian J Neurosurg 2019;14:1268-74.
9. Jia ZY, Song YS, Sheen JJ, Kim JG, Lee DH, Suh DC. Cannulation of occluded inferior petrosal sinuses for the transvenous embolization of cavernous sinus dural arteriovenous fistulas: Usefulness of a frontier-wire probing technique. AJNR Am J Neuroradiol 2018;39:2301-6.
10. Konstas AA, Song A, Song J, Thanos A, Ross IB. Embolization of a cavernous carotid fistula through the vein of Labbé: A new alternative transvenous access route. J Neurointerv Surg 2018;10:e11.
11. Korkmazer B, Kocak B, Tureci E, Islak C, Kocer N, Kizilkilic O. Endovascular treatment of carotid cavernous sinus fistula: A systematic review. World J Radiol 2013;5:143-55.
12. Kuwayama N, Endo S, Kitabayashi M, Nishijima M, Takaku A. Surgical transvenous embolization of a cortically draining carotid cavernous fistula via a vein of the sylvian fissure. AJNR Am J Neuroradiol 1998;19:1329-32.
13. Matsumoto A, Okauchi M, Shindo A, Kawanishi M, Tamiya T. Cavernous sinus dural arteriovenous fistula treated by facial vein direct puncture: Case report and review of the literature. Interv Neuroradiol 2017;23:301-6.
14. Meyers PM, Halbach VV, Dowd CF, Lempert TE, Malek AM, Phatouros CC, *et al*. Dural carotid cavernous fistula: Definitive endovascular management and long-term follow-up. Am J Ophthalmol 2002;134:85-92.
15. Newton TH, Hoyt WF. Dural arteriovenous shunts in the region of the cavernous sinus. Neuroradiology 1970;1:71-81.
16. Rhoton AL Jr. The cerebral veins. Neurosurgery 2002;51 Suppl 4:S159-205.
17. Sato S, Kokubo Y, Kawanami K, Itagaki H, Yamada Y, Matsumoto Y, *et al*. Hybrid surgical and endovascular approach via the contralateral superficial middle cerebral vein to occlude cavernous sinus dural arteriovenous fistula in a hybrid operating room: A case report. NMC Case Rep J 2021;8:137-42.
18. Shimizu Y. Superficial middle temporal vein as a pivotal route to embolize dural carotid-cavernous fistulas. J Clin Neurosci 2021;84:106-10.
19. White JB, Layton KF, Evans AJ, Tong FC, Jensen ME, Kallmes DF, *et al*. Transorbital puncture for the treatment of cavernous sinus dural arteriovenous fistulas. AJNR Am J Neuroradiol 2007;28:1415-7.

How to cite this article: Iampreechakul P, Wangtanaphat K, Hangsapruek S, Wattanasen Y, Lertbutsayanukul P, Siriwimonmas S. Transfemoral transvenous embolization through the vein of Trolard and superficial middle cerebral vein for cavernous sinus dural arteriovenous fistula with isolated cortical vein drainage: A case report and literature review. Surg Neurol Int 2022;13:34.