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Endovascular treatment of isolated transverse sigmoid sinus dural arteriovenous fistula using Onyx liquid embolic system

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***Abstract* - A dural arteriovenous fistula (DAVF) with isolated sinus exists in a network of small vessels opening into the wall of a completely thrombosed sinus that disallows any venous access, either anterograde or retrograde. Despite recent advances in treatment modalities, including endovascular and neurosurgical approaches, some patients with DAVFs with isolated sinus are difficult to treat both anatomically and clinically [5-7].**
In this paper, we report initial five isolated transverse-sigmoid sinus DAVFs treated transarterial embolization using Onyx.

***Index Terms* - isolated dural arteriovenous fistula, transarterial embolization, Onyx, liquid embolic material, endovascular treatment**

I. INTRODUCTION

Isolated transverse-sigmoid DAVF often exhibit the cortical venous drainage, and present with hemorrhage or neurologic deficit, and prompt treatment is indicated. Endovascular treatment has traditionally included embolization via an arterial or venous route with use of acryl glue, particles, coils, or a combination. Recently, the use of Onyx (ev3) via the arterial route has been reported with promising resultsp[3, 9, 12].

Onyx (Fig 1.) is comprised of ethylene vinyl alcohol (EVOH) copolymer dissolved in dimethyl sulfoxide (DMSO), and suspended micronized tantalum powder to provide contrast for visualization under fluoroscopy. Onyx is available in two product formulations. Onyx 18 (6% EVOH) and Onyx 34 (8% EVOH). Onyx 18 will travel more distally and penetrate deeper into the affected artery due to its lower viscosity compared to Onyx 34.

In this paper, we present initial five cases with isolated transverse-sigmoid DAVF and discuss the feasibility and safety of Onyx liquid embolic system.

II. PATIENTS AND METHODS

Five consecutive patients were treated for isolated DAVF involved transverse-sigmoid sinus using Onyx between July 2007 and November 2012 (Table I). There were 4 men and 1woman, ranging from 52 to 85 year of age (mean 67.4 years old).

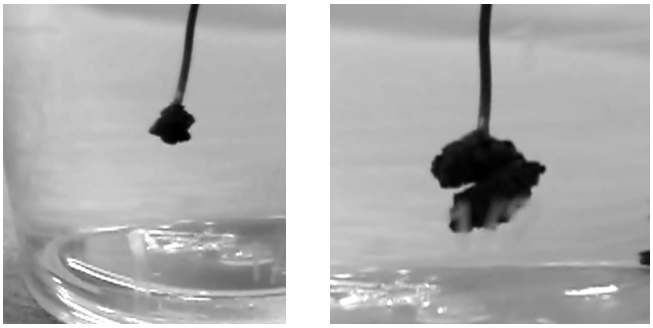

Fig 1. Onyx

Onyx is a non-adhesive liquid embolic agent comprised of EVOH (ethylene vinyl alcohol) copolymer dissolved in DMSO, and suspended micronized tantalum powder to provide contrast for visualization under fluoroscopy. When this mixture contacts aqueous media, such as blood, DMSO rapidly diffuses away from the mixture, causing in situ precipitation and solidification of the polymer, with formation of a spongy embolus and without adhesion to the vascular wall.

Fistula of all patients was located at the transverse-sigmoid sinus in all cases with cortical reflux. All endovascular procedures were performed under local anesthesia and in a biplane angiographic unit (Philips Medical System). After trans femoral puncture and 6F sheath placement, a 6F guiding catheter was navigated as possible distal to the external carotid artery. Marathon micro catheter (ev3) was navigated into the feeding vessels of the DAVF as close to the shunting point. Embolization of the DAVF was performed with Onyx 34 or Onyx 18. The technique we used to inject Onyx is comparable with the technique for the treatment of the brain arteriovenous malformations. Onyx dose not react with or stick to the vessel wall; it merely fills the vessel lumen [8]. It is important to completely fill all vessels involved in the fistulous complex; deposition of Onyx in the proximal draining vein only may not be sufficient to completely occlude the fistula or may give rise to recurrence at follow-up [9]. The end point of the embolization was the complete angiographic obliteration of the fistula.

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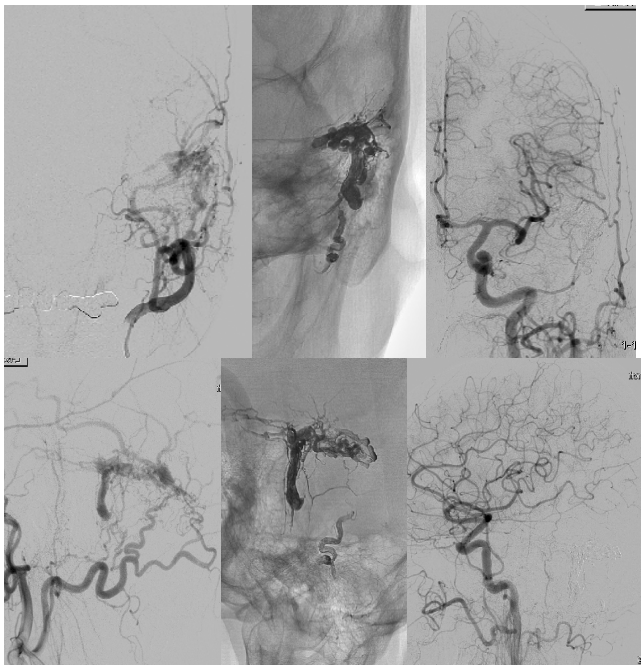
Table 1. Patient and treatment characteristics of 5 patients with isolated transverse sigmoid DAVFs

	Sex	Age	Presentation	Principal arterial supply	site, No. and duration of Onyx injection	Complication
1	M	52	intracranial hemorrhage	MMA, OA	MMA, 1 infection, 23 min, OA, 1 injection, 9 min	IXth, Xth, Xith nerve dysfunction
2	M	60	general convulsion	MMA, OA, tentorial artery	MMA, 2 injection, 20 min, 14 min	-
3	M	75	general convulsion	MMA, OA ascending pharyngeal artery	MMA. 2 injection, 8min, 14 min	-
4	F	85	numbness of upper limb	MMA, OA	MMA, 3 injection, 7 min, 26 min, 12 min	-
5	M	65	intracranial hemorrhage	MMA, OA	MMA, 2 injection, 7 min, 30 min	-

III. RESULTS

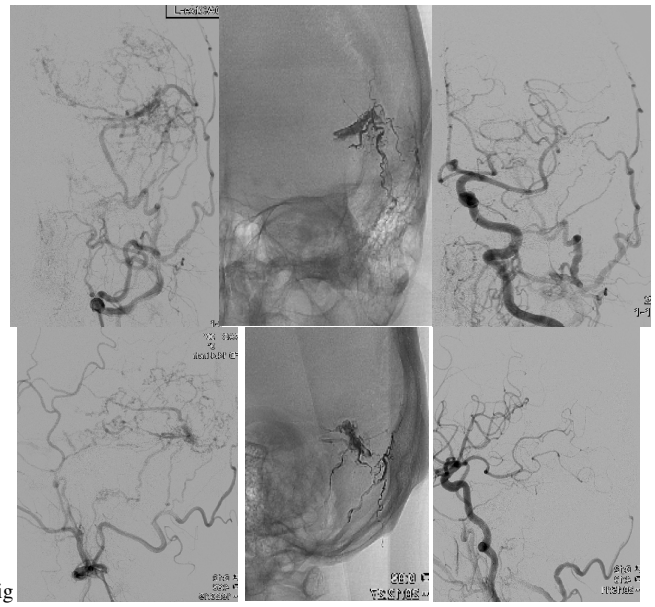
One patient was treated with Onyx for residual fistula after transvenous embolization with coils. All patienst were performed transarterial embolization using Onyx in a single session. Four of the 5 patients obtained complete obliteration of the fistula after the embolization. One patient with multiple DAVF had a residual another DAVF. The duration of the Onyx infection was 5 to 45 minutes. In all cases, removal of the microcatheter was uneventful. One patient demonstrated IXth, Xth, XIth cranial nerve dysfunction after embolization of the brunch of the occipital artery. One month after the treatment, the dysfunctions was not resolved.

Fig 2. case 2

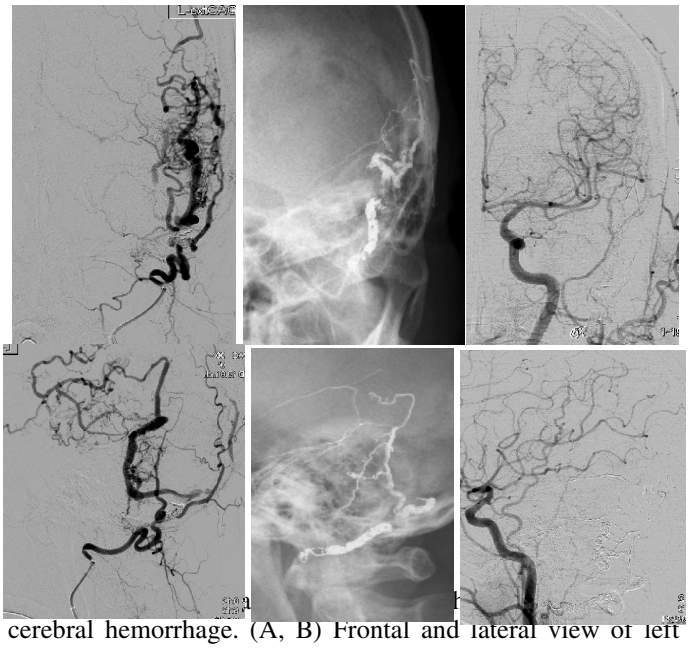


A 60-year-old man (case 2) presented with general seizure and intracranial bruits. (A, B) Frontal and lateral projection of the left external carotid angiogram showing a transverse-sigmoid sinus DAVF supplied by the transosseous branches of the occipital artery, the middle meningeal artery. (C) Plain image of the cranium in frontal and lateral projection showing the cast of Onyx. (D, E) Final angiogram of the left common carotid artery showing the total DAVF occlusion.

Fig



A 75-year-old man (case 3) suffered from subarachnoid hemorrhage and general seizure. (A, B) Frontal and lateral view of left external carotid angiogram showing a isolated transverse-sigmoid sinus DAVF with cortical venous reflux. (C, D) Plain image of the cranium in frontal and lateral projection showing the cast of Onyx. (E, F) Final left common carotid angiogram showing the total DAVF occlusion.



cerebral hemorrhage. (A, B) Frontal and lateral view of left occipital angiogram showing an isolated sigmoid sinus DAVF. (C) Plain image of the cranium in lateral projection showing the cast of onyx. (D, E) Final left common carotid angiogram showing the total DAVF occlusion.

IV. Discussion

DAVFs with retrograde flow into the cortical veins exhibit a much higher incidence of hemorrhage or venous infarction. The annual mortality rate for lesions with cortical venous reflux may be as high as 10.4%, whereas the annual risk for hemorrhage or non hemorrhagic neurologic deficits during follow-up is 8.1% and 6.9%, respectively, resulting in an annual event rate of 15% [1].

Endovascular techniques are frequently used as the first treatment for most the DAVFs. In recent years, there have been significant developments in the endovascular treatment of DAVFs via an arterial or venous approach. Treatment of transverse-sigmoid sinus DAVF has been usually performed via a venous approach and packing with coils. However, in isolated sinus case of DAVF it may be difficult or impossible to access the affected sinus. Sometimes surgical puncture of the sinus may be required. In such cases, arterial Onyx embolization may be an effective and alternative treatment. Our initial experience in a small series by using Onyx confirms the good results.

In 2006, Rezende et al [2] reported the first case of DAVF occluded using Onyx in a patient with lesser sphenoid wing fistula with direct cortical venous drainage. Subsequently, other case reports and case series were published [3, 4]. Embolization of DAVFs of Cognard Type III to V using Onyx is feasible with promising results recently. Compared with n-butyl-2-cianoacrylate (NBCA) , Onyx presents a liquid form when injected and a solid form when in contact with blood through precipitation after DMSO evaporates, thus allowing for slower and longer injection rates, which can be better controlled [7]. Furthermore, because of its non-adhesive nature and penetration characteristics, Onyx is a promising embolic agent for endovascular treatment of DAVFs involving venous sinus. Cognard et al presented a series of 30 patients with DAVFs. A complete angiographic cure was achieved in 92% [4]. Xianli et al. reported clinical cures in 52%, and permanent complications occurred in 4% and transient complications in 24% [10]. Transarterial embolization using liquid embolic material may provide a risk of cranial nerves damage because of the numerous dangerous anastomoses involved in these areas and because the vascular supply of the cranial nerves may be jeopardized [11]. In our 5 cases, we treated isolated transverse-sigmoid sinus DAVFs with cortical drainage. DAVFs were occluded in all cases using Onyx with single or multi-session treatment.

One patient demonstrated ninth to eleventh nerve dysfunction after embolization of the feeding artery from the occipital artery embolization, which did not recovered at 2-month follow-up. In some literatures, this cranial dysfunction was resolved after 2 to 4 month [10]. We need careful clinical observation of this patient.

In the DAVFs like the present series with Cognard type IIb, the initial venous catheterization in the sinus for coil embolization of the sinus sometimes failed. For those patients, arterial Onyx liquid embolic system was chosen, because recanalization of the thrombosed sinuses was often not possible. The important risk in isolated DAVF is a migration of Onyx from the sinus to the arterialized draining veins, which may cause distal venous occlusion and consequent venous infarction or hemorrhage [4]. Therefore, Onyx was slowly injected into affected sinus with careful manipulation. Due to Onyx is a non-adhesive liquid embolic agent, slowly and pause injection is possible to successful obliterate the isolated transverse-sigmoid DAVFs.

V. Conclusion

With our small experience, the use of Onyx for transarterial embolization of isolated transverse-sigmoid DAVFs is safe and results are encouraging. Onyx embolization of isolated transverse-sigmoid sinus DAVF is an alternative endovascular treatment and can achieve high cure rates

Acknowledgment

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