Transvenous Endovascular Treatment for Scalp Arteriovenous Fistulas: Results with Combined Use of Onyx and Coils

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■ BACKGROUND: **Scalp arteriovenous fistulas (AVFs) are rare lesions that may occur spontaneously or secondary to head trauma. A standard treatment strategy for these lesions has not been established to date. We present 3 cases of successful treatment of scalp AVFs using a combination of Onyx-18 and coils via a transvenous approach.**

■ METHODS: **The patient database at Huashan Hospital, Fudan University, Shanghai, China was reviewed, and patients with scalp AVFs treated with Onyx-18 and coils via a transvenous approach were identified for analysis.**

■ RESULTS: **Between 2014 and 2016, 3 consecutive patients with scalp AVFs were treated transvenously with Onyx embolization in combination with coil placement at our hospital. No procedure-related complications were noted. Postembolization angiography demonstrated successful and complete occlusion of the AVFs immediately after treatment. Clinical follow-up showed resolution of symptoms.**

■ CONCLUSIONS: **The technique of transvenous "armored concrete" embolization using a combination of coils and Onyx is an effective treatment modality for scalp AVFs, particularly in type C cases.**

INTRODUCTION

Scalp arteriovenous fistulas (AVFs) are rare lesions with anomalous connections between feeding arteries and draining veins without an intervening capillary network in the subcutaneous fatty layer of the scalp.[1,2] They may occur spontaneously, secondary to a head trauma, or iatrogenically, including after hair transplantation or craniotomy.[3-5] As a result of an abnormal hemodynamic, scalp AVFs develop initially as a small subcutaneous swelling that can enlarge to produce a palpable scalp mass from dilated veins, causing tremendous cosmetic, functional, social, and psychological disturbances.[6] These lesions can also present with such symptoms as bruits, tinnitus, headache, local pain, epilepsy, hemorrhage, and scalp necrosis. In the past, surgery was the first choice for treating these lesions.[7-9] Recently, endovascular embolization has been used with increasing frequency as the dominant treatment of scalp vascular lesions.

Onyx (ev3 Endovascular; Medtronic, Minneapolis, Minnesota, USA), a liquid embolic agent consisting of ethylene-vinyl alcohol dissolved in dimethyl sulfoxide, has become available for treating scalp AVFs.[10,11] Although endovascular occlusion of the fistulas with Onyx is currently standard treatment for AVFs, various treatment modalities have been associated with variable outcomes. Transarterial use of Onyx is limited in scalp AVFs due to the complex, fine, and serpiginous feeding arteries, which increase the risk of proximal reflux and catheter entrapment. Transvenous Onyx injection is an accepted alternative treatment leading to retrograde thrombosis of the fistula if the draining vein is dilated and approachable. However, the biggest challenge for the transvenous approach is the increased risk of recanalization and pulmonary embolization.

The combined use of coils and Onyx (known as the "armored concrete" treatment modality) to treat dural AVFs has been reported. In this modality, tight packing of coils with Onyx is critical to avoid recurrence; Onyx is allowed to diffuse within and around the coil scaffold to decrease the risk of reflux. Halbach et al.[12,13] have reported the use of transvenous embolization techniques in combination with coils or liquid embolic agents to completely obliterate dural AVFs; however, this "armored concrete" treatment modality has rarely been reported in the treatment of scalp AVFs.

Here we describe 3 cases of scalp AVFs successfully treated with Onyx embolization as an adjunct after coil deployment through the transvenous approach.

Key words
- Armored concrete technique
- Scalp arteriovenous fistula
- Transvenous embolization

Abbreviations and Acronyms
AVF: Arteriovenous fistula
DSA: Digital subtraction angiography
STA: Superficial temporal artery
STV: Superficial temporal vein

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METHODS

The patient database at Huashan Hospital, Fudan University, Shanghai, China was reviewed. The hospital's Research Ethics Board approved the study protocol.

RESULTS

Between 2014 and 2016, 3 consecutive patients with scalp AVFs were treated transvenously with Onyx embolization in combination with coil placement at our hospital. Scalp AVFs developed after head trauma in 2 patients and after craniotomy in 1 patient. All patients presented with a palpable, pulsatile scalp mass with bruits or tinnitus.

Case 1

A 19-year-old man presented with an 18-month history of a left-sided increasingly audible bruit, as well as a progressively enlarging pulsatile mass after sustaining brain trauma. Physical examination revealed a tender, pulsatile mass in the left temporal region measuring 5 × 4 cm (Figure 1).

Selective digital subtraction angiography (DSA) demonstrated the presence of a scalp AVF with multiple orifices provided by a number of small, fine serpiginous arteries emanating from the left superficial temporal artery (STA) and occipital artery and draining to a large left superficial temporal vein (STV). Treatment of the AVF was initially attempted by an intra-arterial approach in a local hospital; however, the tortuosity of the STA precluded access of fistula by the microcatheter. In addition, the small size of the feeders prevented the Onyx from penetrating sufficiently in the fistula nidus. Thus, 0.5 mL of Onyx-18 was injected to occlude 1 of the arterial feeders, and the AVF was not cured.

After the patient was admitted to our hospital, we analyzed the angioarchitecture of the AVF and decided to treat it via a venous approach. Based on the single major drainage vein to the external jugular vein, we chose to reach the AVF through a transfemoral retrograde transvenous approach. A double microcatheter

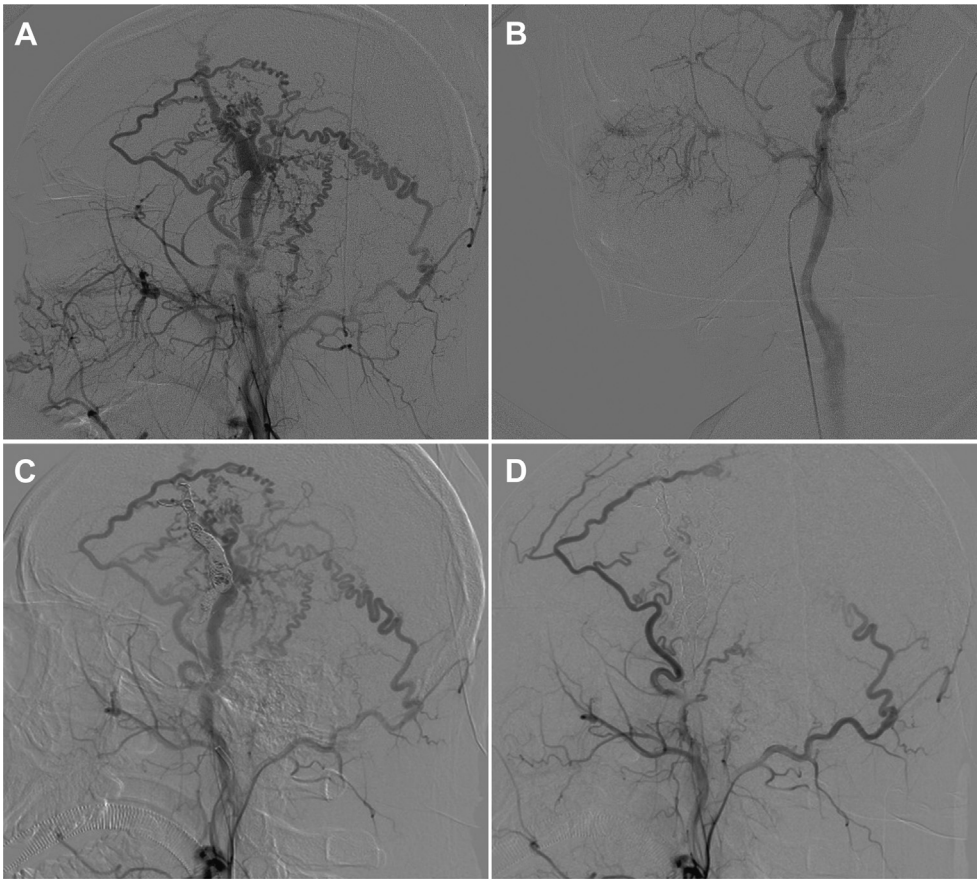

Figure 1. The patient presented with a progressively enlarging pulsatile mass after sustaining brain trauma. (**A**) Cerebral angiography demonstrated the presence of scalp arteriovenous fistulas (AVFs) in the left temporal region. (**B**) Left external carotid injection confirmed the single drainage of dilated superficial temporal vein (STV) to the external jugular vein (EJV). (**C**) Several coils were deployed in an STV punch proximal to the fistula. (**D**) Postembolization angiography demonstrated complete occlusion of the AVFs immediately after transvenous Onyx-18 injection.