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Embolization of peripheral high-flow arteriovenous malformations with Onyx

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KEYWORDS
Embolization;
AVM;
Ethyl vinyl alcohol copolymer (Onyx)

Abstract
Purpose: The aim of this study was to report our experience in embolization of high flow peripheral arteriovenous malformations (AVMs) with Onyx.

Material and methods Retrospective study of Nineteen patients (10 men, 9 women) with peripheral high-flow AVMs who were treated with arteruial embolization using Onyx were retrospectively included. AVMs were located in the head and neck (6), extremities (5), chest (2), kidney (2), uterus (2), pelvis (1) and parietal (1). In 13 patients, embolization was done using Onyx only. One patient underwent embolization by direct puncture, the others by transarterial approach. Embolization was performed in one or multiple sessions (up to 5). A total of 28 sessions were performed. Follow-up was performed with a delay between 10 and 34 months.
Results: Technical success was achieved in all patients. Complete devascularization was obtained in 12 patients. Surgical excision was performed in 9 patients. Non-target Onyx embolization was not observed. One patient developed stroke. In 1 patient microcatheter

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fracture occured. One patient presented severe pain and bradycardia during the procedure that disappeared shortly after. One patient had persistent but less frequent epistaxis after embolization. Another patient had persistent pain without improvement. One patient was lost to follow-up. Other patients were free of symptoms on follow-up.

Conclusions: Embolization with Onyx® is an interesting option for management of peripheral high-flow AVMs either preoperatively or as a single treatment.

Arteriovenous malformations (AVMs) are vascular lesions that consist of arteriovenous microfistulae through a vascular nidus. They can occur anywhere in the body. Symptoms and signs of AVMs depend on the site, size, and degree of arteriovenous shunting through the lesion. Their etiology is commonly congenital [1]. Trauma may sometimes reveal underlying dormant AVM. The management of peripheral AVMs (pAVMs) is very challenging. Curative surgical treatment is feasible in early stage lesions; however, during these stages AVMs are usually quiescent and asymptomatic, so conservative treatment seems to be a reasonable choice [2]. With various stimuli (hormonal, traumatic, incomplete surgery or embolization), lesions may rapidly progress to higher stages, associated with more complex and difficult management. In case of diffuse lesions, surgery is associated with significant morbidity and carries a high likelihood of recurrence [3]. Ligation of feeding arteries is only temporarily effective and is almost obsolete nowadays as it clearly stimulates neoangiogensis and cuts off any possible further endovascular access.

Endovascular embolization has been suggested as a treatment option since the early 1970s. Its aim is either palliative in symptomatic patients with impossible surgical resection or to minimize intra-operative hemorrhage and facilitate complete resection [4]. The ethylene vinyl alcohol copolymer (EVOH: Onyx; ev3-Covidien, Irvine, CA, USA) is a non-adhesive liquid embolic agent that has been used since the early 1990s [5]. Onyx is proved to be safe and efficient embolic agent in management of brain AVMs [6]. Peripheral use of Onyx has been published in few case reports with promising results [7—9].

The aim of this study was to report our experience in embolization of pAVMs with Onyx.

Materials and methods

A retrospective review of the medical records and imaging studies of patients treated by embolization with EVOH (Onyx) from July 2008 to March 2012 for pAVMs in the department of interventional radiology (Hôpital La Timone, Marseille, France) was performed. All patients were managed by a multi-disciplinary team dealing with peripheral vascular malformations (plastic surgeons, interventional radiologists, pathologists and dermatologists). Patients were encountered by the team with previous dynamic magnetic resonance angiography (MRA) study and/or Doppler ultrasound. A consensus decision of embolotherapy followed or not by surgery were decided upon patient's complaint and angioarchitecture on dynamic contrast-enhanced MRA study. The patient's consent (or parents' consent in minor patients) was always obtained after explanation of the treatment and its potential complications. This study included 19 consecutive patients (10 men, 9 women) with a mean age of 36.5 years (range: 2—72 years). Data concerning lesion location, clinical presentation and previous interventions (surgery or embolizations) were reviewed. Number of embolization sessions and their technical details (approach, material used, type and quantity of Onyx used, association to other embolic agent) were analyzed. Technical results and complications of the procedures were registered. Patients were followed-up for an average period of 19 months (range 10—34 months) by clinical examination, imaging (ultrasound and/or MRI) or phone communication for clinical success (relief, persistence or recurrence of symptoms) or delayed complications. Table 1 summarizes patients' age, gender, AVM location, clinical presentation, Schobinger clinical stage, previous interventions, number of embolization sessions, quantities and concentrations of Onyx used, other embolic agents used, complications, technical and clinical results and follow-up duration.

Embolization technique

Eighteen patients underwent preliminary diagnostic angiography via a percutaneous transarterial approach. During the same session, the embolization procedure was performed. One patient underwent embolization at a second session after the diagnostic angiography because a second multidisciplinary discussion was required. All embolization procedures were performed by a transarterial approach. In one patient, this was changed into direct percutaneous puncture of the nidus due to difficult navigation of the microcatheter secondary to vasospasm that occurred before Onyx injection. Transvenous approach, external compression, and balloon protection techniques were never used. In 18 patients, the procedure was performed by right femoral puncture with introduction of a 6 Fr sheath followed by the introduction of a 6 Fr guiding catheter to allow per-procedure angiograms with the microcatheter in place. Patient No. 1 required a 4 Fr introducer and a 4 Fr vertebral catheter because of his young age (2 years). No anticoagulation was done during the procedures. A dimethyl sulfoxide (DMSO)-compatible microcatheter (Echelon-14 or Echelon-10, ev3, Irvine, CA, USA) was used to perform

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