

Absolute Ethanol Embolization Combined with Surgical Resection of Scalp Arteriovenous Malformations: Interim Results

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ABSTRACT

Purpose: To assess treatment methods, interim results, and complications of absolute ethanol embolization combined with surgical resection of scalp arteriovenous malformations (AVMs).

Materials and Methods: From September 2012 to January 2015, 15 consecutive patients (8 male and 7 female) with scalp AVMs underwent staged ethanol embolizations. Ethanol embolization was performed using transcatheter and/or direct puncture techniques. Ten patients with scalp AVMs with a dominant outflow vein (DOV) also underwent coil deployment before ethanol embolization. Two patients underwent surgical resection after ethanol embolization was achieved. Follow-up evaluations included clinical outcome of symptoms and signs and imaging at 1.5 months, 6 months, and annually thereafter.

Results: In 15 patients, 33 ethanol embolizations were performed; 16 coil deployments were performed in 10 patients who had scalp AVMs with a DOV. Of 15 patients, 8 (53.3%) were cured, 2 of whom underwent surgical resection. All 8 patients showed no recurrence in the follow-up period (range, 12–48 months; mean, 25 months). Seven patients (46.7%) had partial remission and will need further treatment sessions for residual AVMs (range, 1–12 months; mean, 7 months). In 3 of 15 patients (20%), 7 minor complications (skin blisters and necrosis) occurred. All minor complications healed with wound dressing and observation. There were no major complications.

Conclusions: Ethanol embolization has the potential for cure in management of scalp AVMs, with an acceptable risk of minor and major complications. Once AVMs are devascularized, surgical resection can be performed to improve cosmetic results.

ABBREVIATIONS

AVM = arteriovenous malformation, DOV = dominant outflow vein

Congenital arteriovenous malformations (AVMs) of the scalp are rare lesions, located within the subcutaneous fatty layer of the scalp. These lesions consist of an abnormal fistulous connection between feeding arteries and draining veins, without the presence of an intervening capillary bed. The draining vessels are grossly dilated and tortuous,

creating a cosmetic deformity of the scalp (1). The principal symptoms of patients with scalp AVMs include tinnitus, headache, and the presence of a pulsating mass (2). Scalp AVMs can also result in bleeding and necrosis (3). Factors such as trauma, partial surgery, and hormonal imbalances (resulting from pregnancy or puberty) can lead to the rapid expansion of these masses (4).

It is notoriously difficult to manage scalp AVMs because of their complex vascular anatomy, high shunt flow, and cosmetic difficulties (5). Treatment methods used to treat these lesions include surgical excision, transarterial and transvenous embolization (6,7), injection of sclerosant into the nidus (8,9), and electrothrombosis (10). These therapies have been used separately or in combination, and diverse outcomes have been reported. Treatment via superselective catheterization or direct puncture of the nidus using absolute ethanol as a permanent embolic agent has shown good

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Table 1. Baseline Demographic Information

Characteristic	Value
Number of patients	15
Male/female patients	8/7
Age, y, median (range)	24 (9–39)
Previous treatment	
Ligation of feeding arteries	2
Partial surgical	4
Embolization	9
Previous embolic agent	
PVA	3
NBCA	4
Bleomycin	2

NBCA = *N*-butyl cyanoacrylate; PVA = polyvinyl alcohol.

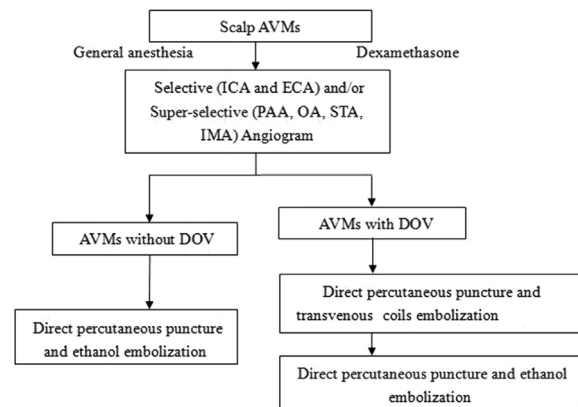
clinical and radiologic results, improving treatment of congenital soft tissue AVMs with an acceptable risk of morbidity (11–14). To our knowledge, only 1 study of ethanol embolization for scalp AVMs has been published, describing 3 patients who were treated with direct puncture of the venous pouch and injection of absolute ethyl alcohol during compression of the venous outflow of the fistula (8). The purpose of this retrospective study was to examine the clinical efficacy and safety of absolute ethanol and coil embolization in combination with surgical resection for treatment of AVMs arising from the scalp.

MATERIALS AND METHODS

Patients

With permission of the institutional review board of the hospital, the clinical and imaging records of 15 consecutive patients who underwent treatment for congenital AVMs of the scalp between September 2012 and January 2015 were retrospectively analyzed. The study group included 15 patients (8 male and 7 female patients) with a mean age of 24 years (age range, 9–39 y). Baseline demographic data are presented in Table 1. Previous ligation of the feeding arteries ($n = 2$), partial surgical resection ($n = 4$), and embolization ($n = 9$) had been performed in 12 patients. Indications for embolization included hemorrhage, recurrent blood oozing, pain or discomfort, and rapid swelling of the lesions.

All patients described a lesion that had been present since birth, evolving from a birthmark to gradually swelling mass, with or without hemorrhage. All patients underwent a thorough physical examination before treatment. Clinical presentations varied, most commonly including redness (all 15 patients), warmth (all 15 patients), pulsation or thrill (all 15 patients), headache (14 of 15 patients), and bruit (7 of 15 patients). Dilatation of the external jugular vein was observed in 10 of 15 patients. A history of hemorrhage and ulceration was present in 7 of 15 patients; none of the patients in this study had necrosis secondary to ischemia or chronic infection. In all patients, facial nerve function was normal and symmetric.



AVMs = Arteriovenous malformations, ICA = Internal carotid artery, ECA = External carotid artery, PAA = Posterior auricular artery, OA = Occipital artery, STA = Superficial temporal artery, IMA = Internal maxillary artery, DOV = Dominant outflow vein.

Figure 1. Schematic depiction of treatment of scalp extracranial AVMs.

Embolization Procedures

All patients received general anesthesia with intubation during angiography combined with ethanol embolization. Dexamethasone (10 mg for adults) was immediately administered before the procedure to minimize soft tissue swelling and accompanying pain. After introduction of anesthesia, a Foley catheter was inserted to monitor the possible presence of hemoglobinuria. Using a femoral arterial approach, bilateral selective internal and external artery angiography was performed. For patients who had external carotid ligation, angiography of the ipsilateral common carotid artery, vertebral artery, thyrocervical trunk, and contralateral external carotid artery was performed instead. To accurately delineate vascular access to compartments of the lesions, superselective angiography of the occipital artery, superficial temporal artery, and posterior auricular artery was then carried out.

Once the routes of endovascular access to the lesions were identified, a microcatheter (Prowler 10; Cordis Endovascular, Miami Lakes, Florida) was wedged into the nidus coaxially to make the subsequent embolization more effective. Initially, this transarterial approach was preferentially used for embolization of AVMs when possible. In all cases, however, feeding arteries were so grossly dilated and tortuous that the microcatheter could not be wedged into the nidus. Thus, a 21-gauge needle was inserted into the nidus under fluoroscopic guidance, and direct angiography was performed. The technique of treating scalp AVMs is summarized in Figure 1.

For high-flow lesions with dominant outflow veins (DOVs) (Fig 2a), coils were used before ethanol embolization via direct puncture and transvenous catheterization. After the lesion region was sterilized and draped, an 18-gauge needle (Cook, Inc, Bloomington, Indiana) was used to percutaneously puncture the DOV, and a venogram was obtained to verify the position of the needle in the DOV (Fig 2b). A 2.1-F microcatheter (Asahi Intecc

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