

Treatment of Scalp Arteriovenous Malformation

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Objective : The object of this study is to present the treatment experience of the 6 cases of scalp arteriovenous malformations (AVMs) focus on treatment strategy.

Methods : Six patients with scalp AVM were treated during past 12 years. We analysis the clinical characteristics of the lesions, treatment methods and management outcomes.

Results : The lesions were located on temporal in 2 patients, parietal in 2 patients, frontal and occipital area in each one. Four of six patients had a trauma history on scalp. The presenting symptoms were progressive enlarged pulsating mass with or without bruit. Four of the six lesions had the large fistula in the lesion. Two patients were treated with surgical resection alone, three patients with proximal feeding artery balloon(s) occlusion followed by surgical resection, and one patient with coil embolization through trans-venous route alone. We obtained good results in all patients.

Conclusion : Most of scalp AVM can be completely cured by judicious selection and a combination of treatment modalities, i.e., surgery only, or embolization only, or embolization plus surgical therapy. Although embolization became a primary therapy for this sort of scalp AVM recently, the selection of treatment modality should be chose based on the size, angioarchitecture, and clinical presentations of the lesion.

KEY WORDS : Scalp arteriovenous malformation · Treatment · Surgery · Embolization.

Introduction

Scalp AVM is rare lesion^{3,7,8,12-14,16,17,19,21,24-26}. Several case reports are existed in domestic literatures^{3,12,14,21,26}. This lesion is defined as an abnormal fistulous connection between the feeding arteries and draining veins, without an intervening capillary bed^{5,6,17,20}. The draining veins are grossly dilated and tortuous and may show variceal dilatation (=cirroid aneurysm)^{1,5,6,8,13,17,20}. Various names applied to cirroid aneurysm include aneurysm serpenticum, aneurysma racemosum, plexiform angioma, arteriovenous fistula, arteriovenous aneurysm, and arteriovenous malformation^{1,2,5,11,18,23}. A progressive growing pulsatile mass, bruit and a throbbing headache are the main complaints of the patients^{1,5,7,8,11,13,15,17,19}. The treatment of lesion is required due to cosmetic deformity, loud bruit, throbbing headache and scalp necrosis. The treatment of scalp AVM is difficult because of its high shunt flow, complicated vascular anatomy, and cosmetic problems. Trans-arterial or trans-venous embolization followed by surgical

excision is required due to massive bleeding during surgery and high recurrence rate after surgical resection.

This report evaluates the results of treatment of 6 patients with scalp AVMs. Two patients were treated with surgical resection alone, three patients with proximal feeding artery balloon(s) occlusion followed by surgical resection, and one patient with coil embolization through trans-venous route alone. This article reviews the results of our treatment and discusses the pathogenesis and treatment strategy of the scalp AVM.

Materials and Methods

Six patients with AVMs of the scalp were treated in our institution between September 1991 and September 2003. The clinical features and methods of treatment of our patients were reviewed based on the retrospective investigation of medical records and radiological findings. The evolvement of the treatment methods which were performed in our patients was also reviewed.

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Table 1. Clinical characteristics of patients with scalp arteriovenous malformation

| No | Age(yr)/ Sex | Location | Tr. Hx | Sx | Type | Feeder | Tx | Rx |
|----|-----------------|------------|-----------|--------------|-------|-----------|---------------------------|----|
| 1 | 55/F | Temp.Lt | Yes | Mass & Bruit | Fist. | IMA & STA | Prox.ballo. & Resect. | E |
| 2 | 22/M | Temp.Rt. | Yes | Mass & Bruit | Fist. | ECA | Prox.ballo. & Resect. | E |
| 3 | 33/F | Pariet.Lt. | No | Mass | Plex. | PA & STA | Prox.ballo & Resect. | E |
| 4 | 41/F | Pariet.Rt. | Yes | Mass & Bruit | Plex. | STA | Resect. | E |
| 5 | 16/F | Fr.Rt | No | Mass | Fist. | STA | Resect. | E |
| 6 | 36/M | Occip.Lt. | Yes | Mass | Fist. | OA & PA | Embol. (fibered coils) | E |

Abbreviations : Tr : trauma, Temp : temporal, Pariet : parietal, Fr : frontal, Occip : occipital, Fist : fistula, Plex : plexiform, IMA : internal maxillary artery, STA : superficial temporal artery, ECA : external carotid artery, PA : posterior auricular artery, OA : occipital artery, Prox : proximal, Ballo : balloon, Resect : resection, Embol : embolization, SX : symptom, TX : treatment, RX : result, E : excellent

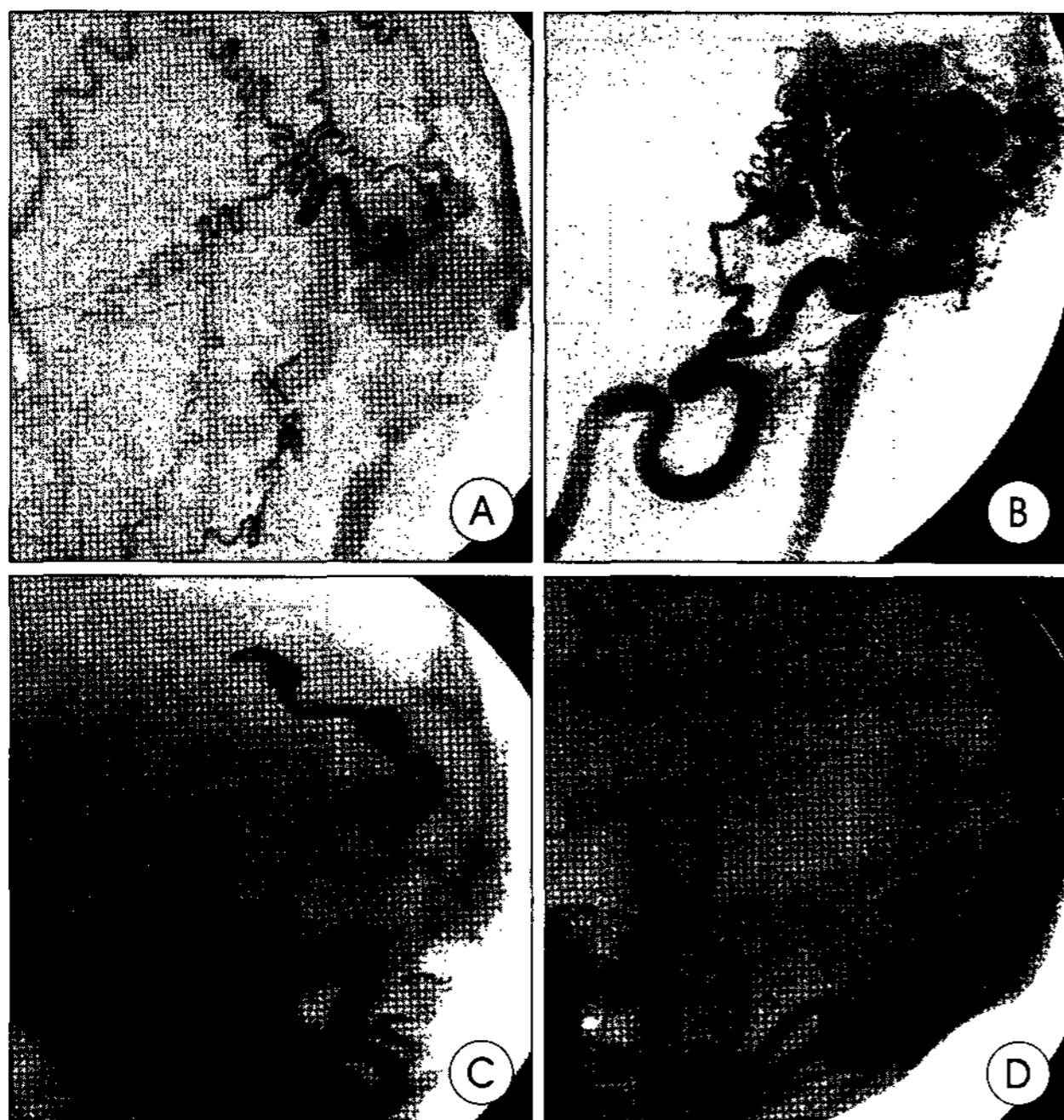


Fig. 1. External carotid artery(A) and super-selected posterior auricular artery angiogram(B) of 36-year-old man who presented with palpable mass on left occipital area, show torturous dilated superficial temporal artery and the enlarged posterior auricular artery promptly opacified the extremely distended superficial vein which drain into internal jugular vein. A complete obliteration of the arteriovenous fistula was achieved by placing total of 9 fibered coils(Tornado coils : Cook, U.S.A) of different sizes in the venous pouch as well as venous outlet immediately adjacent to the fistula(nidus) using a femoral transvenous approach. Post-embolized anterior-posterior(C) and lateral(D) angiograms reveal complete disappearance of the lesion.

Results

Clinical characteristics of the patients

The clinical characteristics of the patients are summarized in Table 1. The age of the patients ranged from 16 to 55year old. There were two males and four females. The lesions were located on temporal in 2patients, parietal in 2 and frontal and occipital area in each one. Four of six patients had a trauma

history on scalp previously. The presenting symptoms of the patients were progressive enlarged pulsating mass with or without bruit. Four of the six lesions had the large fistulae in the nidus, and another two lesions had plexiform type of fistulae in their lesions. The lesions received blood supply from the branches of the external carotid artery, such as internal maxillary artery, superficial temporal artery, posterior auricular artery, and occipital artery.

Treatment methods

Two patients were treated with surgical resection alone. The size of these lesions were relatively small compared to other cases. The scalp flap was made with its base across the main feeding vessels. The scalp incision was made in short segments with careful hemostasis obtained by ligating or coagulating the feeding vessels or drain veins as they are encountered. The scalp flap was reflected and then an incision was made into the galea at the base of the flap. The main feeding vessel (superficial temporal artery in both cases) was ligated, and then the lesion from the subcutaneous tissue was removed carefully without making any defect on the skin. Large amount of blood loss during surgery was encountered in one patient.

Three patients were treated with proximal feeding artery balloon(s) occlusion followed by surgical resection of the lesions. One day prior to surgery, the proximal portion of the main feeder (external carotid artery in all cases) was occluded with detachable balloon. The vascular mass was excised by dissecting it from surrounding tissue with previously described surgical method. A large lesion which located on left preauricular temporal area was removed totally without making any cosmetic problems.

One patient was treated with metal coils (Tornado coils : Cook, U.S.A) embolization alone through femoral transvenous route. The lesion was located in the occipital area. External carotid and super-selected posterior auricular artery angiograms revealed torturous dilated superficial temporal and posterior auricular artery which promptly opacified the extremely distended superficial vein and drained into internal jugular vein.

A complete obliteration of the arteriovenous fistula was achieved by placing total of 9 fibered coils (Tornado coils : Cook, U.S.A) of different sizes in the venous pouch as well as venous outlet immediately adjacent to the fistula (nidus) using a femoral trans-venous approach (Fig. 1).

Outcomes

We obtained good results in all patients without recurrence during follow-up period from 14 months to 156 months. Any cosmetic problems except surgical skin scar were not developed in our patients after treatment.

Discussion

Although controversy still exists regarding the pathogenesis of scalp AVM, it is generally accepted that they may be either of congenital or traumatic origin^{11,16,18}, with the congenital lesion being the more commonly encountered variety⁵. In terms of pathogenesis of congenital type, it originated from the anomalous embryonic development of the vascular system. Developmental arrest of the scalp vascular system in the capillary network stage results in the formation of a hemangioma. The persistence of connections of the embryonal capillary network in the later stage leads to the formation of intercommunicating channels of varying forms between the mature arteries and veins. This may result in formation of mixed hemangioma, arteriovenous(A-V) fistula, or both^{19,22,23}.

Acquired traumatic lesions may be related to fistula formation at the time of blunt or penetrating injuries. The lesions undergo hypertrophy over periods of months to years to become clinically recognizable¹. At least two mechanisms have been suggested for the formation of the traumatic A-V fistula of the scalp¹. One is the laceration theory in which simultaneous lacerations of the artery and of the accompanying vein result in a single fistula. The other is the disruption theory of the vasa vasorum of the arterial wall in which endothelial cells proliferation from the vasa vasorum into the hematoma around the disrupted vasa vasorum form endothelial buds and numerous small vessels. If these newly formed vessels make contact with the adjacent veins, blood will be shunted from the arterial system to the lower pressure venous system, and thus numerous A-V vascular channels will be created. In our cases, four cases are thought to traumatic origin and 2 cases are regarded as congenital origin.

Treatment of scalp AVM is not simple. Radical surgical excision has been the most common method in the past for obliterating scalp A-V fistula^{2,3,5,11-13,16,17,22,23,25,26}. These procedures were necessarily extensive, and all of the fistula had to be removed to obtain a cure. Incomplete removal of fistula has nearly always been followed by recurrence due to recruitment of the collateral blood supply^{1,5}. The complete removal of pericranial component is important for the prevention of recurrence⁵. The loss of large amount of blood during excision is an inevitable event. Therefore, preoperative lodging of embolic material in proximal feeding vessels decrease the blood loss during excision of the lesion^{14,15}. We performed pre-

operative feeding artery occlusion by detached balloon in three cases.

Embolization has become a primary therapeutic method for scalp A-V fistula recently. The lesions are obliterated with injection of liquid embolic material by femoral trans-arterial or trans-venous route under mechanical compression of draining veins to close the fistulae and to prevent the escape of embolic materials into the venous circulation¹⁹. Trans-venous embolization is more successful in the complete obliteration of fistula rather than trans-arterial approach¹. Some authors^{1,4,6,19} recommend direct percutaneous puncture of the engorged scalp vein and injection of liquid embolic material into the lesion. Surgical intervention should be reserved for removal of residual fistulae that cannot be embolized. Operative removal of the lesion can then be performed easily, with minimal blood loss. Nagasaka et al.¹⁹ also recommended that en bloc resection of the scalp and subsequent reconstruction should be planned if surgical therapy is required, because excision of the malformation by dissecting it from the scalp may develop problem of wound healing frequently.

In terms of embolic material for permanent occlusion of fistula, cyanoacrylate liquid material is recommended as a primary choice for embolization^{4,6,19}. However, metal coils⁷, sodium tetradecyl sulfate⁸, polyvinyl alcohol particle⁹, absolute ethyl alcohol¹⁸ and Gelfoam pledget¹⁰ were used as an embolic material in the literatures. We treated one patient with metal coils embolization via femoral trans-venous approach successfully.

Conclusion

Most of scalp AVM can be completely cured by judicious selection and a combination of treatment modalities, i.e., surgery only, or embolization only, or embolization plus surgical therapy. Although embolization became a primary therapy for this sort of scalp A-V fistula recently, the selection of treatment modality should be chosen based on the size, angioarchitecture, and clinical presentations of the lesion.

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