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Endovascular Management of Vertebrobasilar Artery Dissecting Aneurysms

Vertebrobaziler Arter Disekan Anevrizmalarının Endovasküler Tedavisi

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ABSTRACT

AIM: The prognosis of VBA aneurysms seems poor and surgical management of VBA dissecting aneurysms is challenging. We evaluated our endovascular experience in management of ruptured and unruptured VBA dissecting aneurysms.

MATERIAL and METHODS: Eleven consecutive patients with eleven VBA aneurysms (3 ruptured and 8 unruptured) between 2008 and 2010 were retrospectively reviewed.

RESULTS: Immediate postprocedural angiograms showed complete occlusion in 5 and subtotal occlusion in 2 aneurysms treated with stent-assisted coiling, whereas no occlusion in 4 aneurysms treated with stenting alone. A clinical improvement or stable outcome was achieved in all patients. There was no complication in our patients and no patient died after treatment. Angiographic follow-up (mean 9.7 months, 1 to 23 months) showed complete cure in 8 aneurysms, subtotal occlusion in 2 and no occlusion in 1.

CONCLUSION: VBA dissecting aneurysms can be managed by endovascular stent placement with or without coiling. In cases that cannot be treated with neurostents, proximal occlusion could be an option.

KEYWORDS: Aneurysm, Vertebrobasilar artery, Embolization

ÖZ

AMAÇ: VBA anevrizmalarının prognozu kötüdür ve VBA disekan anevrizmalarının cerrahi tedavisi zordur. Rüptüre olmuş veya olmamış VBA disekan anevrizmalarının tedavisinde endovasküler deneyimimizi değerlendirdik.

YÖNTEM ve GEREÇLER: 2008 ve 2010 yılları arasında görülen VBA anevrizması bulunan (3 rüptürlü ve 8 rüptürsüz) arka arkaya 11 hasta retrospektif olarak gözden geçirildi.

BULGULAR: İşlemden hemen sonraki anjiyogramlar stent yardımlı sarmal konması ile tedavi edilmiş olan 5 anevrizmada tam oklüzyon ve 2 anevrizmada subtotal oklüzyon ve sadece stent konarak tedavi edilmiş 4 anevrizmada oklüzyon bulunmadığını gösterdi. Tüm hastalarda klinik bir düzelme veya stabil sonuç elde edildi. Hastalarımızda bir komplikasyon olmadı ve hiçbir hasta tedaviden sonra ölmedi. Anjiyografik takip (ortalama 9,7 ay, 1-23 ay) 8 anevrizmada tam kür, 2 anevrizmada subtotal oklüzyon ve 1 anevrizmada oklüzyon bulunmamasını gösterdi.

SONUÇ: VBA disekan anevrizmaları sarmal konarak veya konmadan endovasküler stent yerleştirmeyle tedavi edilebilir. Nörostentlerle tedavi edilemeyen vakalarda proksimal oklüzyon bir seçenek olabilir.

ANAHTAR SÖZCÜKLER: Anevrizma, Vertebrobaziler arter, Embolizasyon

INTRODUCTION

VBA dissecting aneurysms are rare lesions associated with significant morbidity and death (26,34,35). The clinical manifestations of VBA dissecting aneurysms include SAH, brainstem compression, or ischemia (4,10,24,33). Regardless of presentation, the prognosis for VBA dissecting aneurysms seems to be worse than that for VA dissecting aneurysms.[35] Management of these lesions is controversial and difficult, and requires particular care. The purpose of this study was to evaluate endovascular management of VBA dissecting aneurysms.

CLINICAL MATERIAL and METHODS

Between 2008 and 2010, we treated 11 patients with a VBA dissecting aneurysm with endovascular techniques. The 11 patients included 7 men and 4 women who ranged in age from 13 to 67 years (mean age 42.2 years). Seven (63.6%) patients with more than 40 years in age had a mean 12-year (range 1- to 30-year) history of hypertension, and no patient had a history of head trauma. Three patients had ruptured VBA dissecting aneurysms and 8 had unruptured dissecting aneurysms. Patient who had atherosclerotic dissections without aneurismal dilation are not considered in this paper.

Endovascular Management

The procedure was performed under general anesthesia and therapeutic heparinization with activated clotting time of approximately 300 seconds. Giant dissecting aneurysms

with enough collateral blood flow were treated with proximal occlusion. Aneurysms with partially thrombosis or mild dilation were treated with stenting alone. Dissections with aneurismal dilation were treated with stent-coiling. Stents placement with or without coiling were performed in 9 patients and proximal vertebral artery occlusion techniques in 2 patients as previously described (11). In all cases, a stent was positioned into the lumen of the parent vessel bridging the aneurysm with reconstruction of the vessel comparable to an "endovascular bypass." The stents available included Neuroform stents, Leo stents and Enterprise stents. Subsequently, the aneurysm was coiled with platinum coils in 5 cases. Immediate post procedure angiograms were obtained and reviewed in multiple views, including standard lateral and anteroposterior projections.

Premedication for Stent Placement

In unruptured VBA dissecting aneurysms, patients were preloaded with the dual antiplatelet agents, 75 mg clopidogrel daily and 200 mg aspirin daily for 3 days before treatment. In ruptured VBA aneurysms, patients were preloaded with 300 mg clopidogrel and 300 mg aspirin 2 hours before procedure. Post procedure, the patients were kept on a dual antiplatelet regimen (75 mg clopidogrel daily and 200 mg aspirin daily) between 3 and 6 months.

Clinical and Angiographic Outcome Measures

Follow-up clinical evaluations were assessed according to the GOS (12). Immediate post procedure and follow-up angiography measured aneurysm occlusion using the Raymond classification scale, (27) which primarily was developed for berry-shaped aneurysms.

RESULTS

Clinical and radiographic results are summarized in Table I. Dissecting aneurysms were characterized by the angiographic appearance with a focal vessel wall irregularity, a peri-aneurismal narrowing and a fusiform dilation. On MRI, intramural thrombus, an irregular vessel wall and a vessel wall flap can be seen. The aneurismal size = ranged from 2.5 to 29 mm (mean 13.0 mm).

Ruptured VBA dissecting aneurysms

Three (27.3%) ruptured dissecting aneurysms (Table I) were found. According to Hunt-Hess grade, one was grade I and two were grade III. One of 3 aneurysms was treated with stent placement alone, and two were treated with stent-assisted coiling (Figure 1A,B; 2A,B). In the aneurysm treated by stenting alone, contrast residual time within the aneurysm was increased moderately after the stent placement. Excellent clinical and technical results were achieved in these 3 patients without any periprocedural complications. A follow-up angiogram was available in these 3 patients at an average of 10.7 months (range, 3 to 20 months). Aneurismal neck recanalization was observed in 1 patient, who was treated with stent-assisted coiling during a 9-month follow-up. Follow-up angiography demonstrated complete occlusion at 3-month follow-up in the aneurysm treated with stenting alone. None of the patients presenting initially with SAH experienced aneurysm rupture during the observation period.

Unruptured VBA Dissecting Aneurysms

Eight (72.7%) patients had unruptured VBA dissecting aneurysms (Table I). Among these patients, 4 (50%) presented with massive effect, 2 (25%) were diagnosed incidentally and 2 (25%) presented with ischemia caused by a dissecting aneurysm. Three unruptured aneurysms were treated with stent-assisted coiling, 3 aneurysms were treated with stenting alone and 2 were treated with VA occlusion. Complete occlusion was observed in 3 aneurysms (1 treated with stent-coiling and 2 with VA occlusion). Filling of a residual base (Raymond Class 2) was observed in 2 aneurysms treated

Table I: Summary of Patients, Aneurysms and Treatments

Patient No.	Age/ sex	Presenting symptoms	Size (mm)	Treatment	Immediate occlusion	Follow-up (months)	Follow-up angiography	Clinical outcome
1	13/M	Headaches	29	Bilateral VA occlusion	100%	16	No recanalization	Good recovery
2	17/M	Ischemic	15	Stent only	0	5	No recanalization	Good recovery
3	28/F	SAH	6	Stent-coiling	100%	22	No recanalization	Good recovery
4	30/M	Headaches	5	Stent only	0	1	Stable	Good recovery
5	42/F	SAH	9	Stent only	0	1	Stable	Good recovery
6	43/F	Incidental	20	VA occlusion	80%	11	No recanalization	Good recovery
7	44/M	Headaches	7	Stent-coiling	100%	23	No recanalization	Good recovery
8	53/F	Incidental	10	Stent-coiling	>90%	3	No recanalization	Good recovery
9	63/M	Headaches	16	Stent only	0	4	No recanalization	Good recovery
10	64/M	SAH	13	Stent-coiling	100%	9	Small recanalization	Good recovery
11	67/M	Ischemic	16	Stent-coiling	>90%	12	No recanalization	Good recovery

with stent-coiling. In the 3 patients treated by stenting alone, increased contrast residual time within the aneurysm was observed after the stent placement. A follow-up angiogram was available in all patients at an average of 9.4 months (range, 1 to 23 months). None of these patients experienced aneurysm rupture during the observation period. No aneurysm showed recanalization. Of the 3 aneurysms treated with stenting alone, follow-up angiography showed complete aneurysm occlusion during a more than 3-month observation period in 2 aneurysms and showed no change at 1-month follow-up in 1. There was no periprocedural complication. The 2 patients who had neurological deficits caused by ischemia experienced improvement at follow-up.

DISCUSSION

Symptoms of VBA aneurysms depend especially on the mech-

Figure 1: A) Left vertebral angiogram in a frontal view shows a dissecting aneurysm of the basilar trunk proximal to the AICA. **B)**Left vertebral angiogram in a frontal view after treatment shows the aneurysm is stented (Enterprise stent, 4.5×28-mm) and coiled completely.

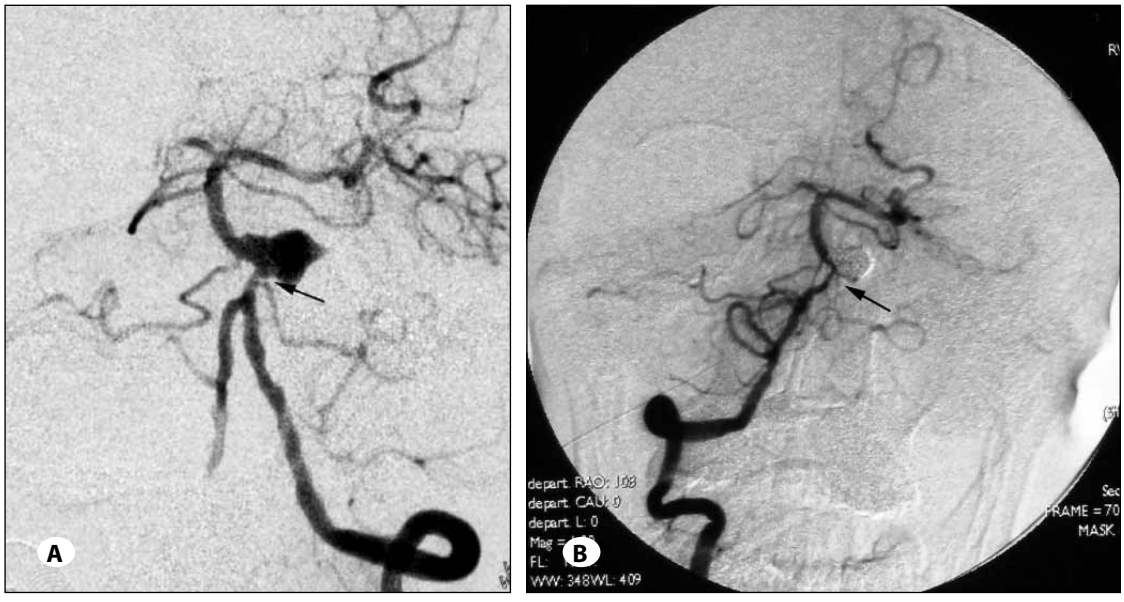

Figure 2: A) Left vertebral angiogram in a frontal view shows a dissecting aneurysm of the basilar trunk at the AICA with the area of dissection (arrow); note the AICA originating within the involved segment. **B)** Right vertebral angiogram in a frontal view after treatment shows the aneurysm is stented (Enterprise stent, 4.5×28-mm) and coiled completely. The AICA was preserved(arrow). Follow-up angiography at 10 months (not shown) shows no coil compaction or aneurysm regrowth.

anism: whether dissecting aneurysm or not, and ruptured or not. Typical presentations include mass effect, subarachnoid hemorrhage or ischemia. VBA dissecting aneurysms are rare and challenging diseases with a high associated morbidity and mortality. The pathogeneses of VBA dissecting aneurysms seems to be fibro-muscular dysplasia in patients less than 40 years in age and hypertension in patients more than 40 years in age (15,16). There is a hypertension history in patients more than 40 years in age and no head trauma history in all patients.

Advances in angiography and MR imaging have increased the recognition that intracranial VBA dissecting aneurysms, unruptured VBA dissecting aneurysms accounts for 72.7% in our study. The natural history, treatment, and outcome of VBA dissecting aneurysms have rarely been analyzed. (2,3,9,12,20,23,25,26). Only in a few cases mentioned in a series on VA dissection, (5,6,13,21,34) approximately 30–70% of patients with ruptured vertebrobasilar dissecting aneurysms will have rebleeding, while smaller percentages will stabilize or improve without treatment (7,10,13,21,33). A review of BA dissection in patients presenting with SAH included eight patients and revealed a death rate of 50% and good recovery in only 25% of patients (9). Pozzati, et al., (26) reported on six patients with dissecting aneurysm of the BA, one of whom died of catastrophic recurrent hemorrhage. The other five patients were treated conservatively, with three eventually making a good recovery. In a review by Masson, et al., (20) 30 of 38 patients died because of their lesions. Brainstem ischemia was the mode of presentation in 27 patients, SAH in five, and both in six. Yoshimoto, et al. (35) reported on 10 patients with BA dissections, 1 of whom died of recurrent hemorrhage. Four patients presented with SAH, 5 patients had brainstem ischemia and 1 presented with mass effect. Eight patients were treated conservatively but did not recover. Rabinov et al (11) reported that the mortality rate in the treated group was 20%, whereas in the untreated group it was 50%. There is likely a selection bias in these literature reviews as higher-grade hemorrhages were seen more often in the untreated group, but VBA dissecting aneurysms thus carried significant morbidity and death whether they presented with ischemia or SAH. Early treatment seems essential for improving the prognosis in these patients.

Treatment strategies of VBA dissecting aneurysms should take the underlying pathomechanism into consideration and include, depending on the presentation, medical treatment, parent vessel occlusion, flow reversal or diversion, surgical options or a combined treatment protocol (2,3,11,28,29,31). A typical VA dissecting aneurysm can be treated relatively safely with either surgical or endovascular proximal artery occlusion (4,8,21). Nonetheless, the risk of producing neurological sequelae as a result of interrupting blood flow of the perforators arising from the VBA appears to be much greater. Ongoing advances in endovascular techniques ultimately may make stent placement with or without coil embolization one of the best management strategies for these lesions. The existing data regarding the use of cerebral stents are promising, but longer follow-up studies are needed to evaluate the dynamics and delayed effects of these stents on the cerebral vasculature. Remarkable flow reduction and decrease in shear stress have been demonstrated in aneurysm sac models by placing a stent alone across the neck of the aneurysm (14,30). Furthermore, the measured flow velocity and shear stress consistently decrease with the addition of each successive stent. Thrombosis of the aneurysm sac has also been reported after a stent is placed across the aneurysm neck even without coil embolization, and this might offer a potential treatment option in selected cases (1,22,32). A group of 28 dissecting aneurysms was treated with this method with no additional stroke or rehemorrhage (31). Our results demonstrate that treatment is indicated for most of these lesions. Our series confirms the efficacy and safety of stent-assisted coiling with the Enterprise device. Moreover, the Enterprise stent appears very easy to navigate and to position, on account of its delivery system and we believe that the Enterprise stent is currently the stent that is easiest to place. The densely woven mesh of current flow diversion stents may constitute a treatment alternative since this mesh may help in pushing the dissection flap back against the wall, thereby preventing further progression of the dissection. However, this new device is still not available in China.

Parent vessel occlusion still plays a role in VBA dissecting aneurysms, which cannot be stented for a giant partially thrombosed aneurysm. Redekop, et al., (28) described a patient with SAH caused by a dissecting aneurysm involving both VAs as well as the basilar trunk; a staged bilateral VA occlusion was performed successfully. After occlusion, the BA was filled in a retrograde fashion through the posterior communicating artery (Pcoma). In another report the authors have described BA (or bilateral VA) occlusion for treatment of complex aneurysms (29). The size of the Pcomas proved to be a good predictor of the ability to tolerate BA occlusion. Basilar artery or bilateral VA occlusion might be considered appropriate treatment in the event of recurrent or progressive enlargement of the BA aneurysm, provided that the patient's Pcomas would provide demonstrably ample collateral flow (16,29). Balloon test occlusion may be of benefit to determine if the collateral circulation is limited anatomically or compromised by vasospasm (11).

Both the clinical course and the therapeutic approach for an unruptured BA dissecting aneurysm are complex (1,5,22,32,35,36). When the lesion involves the BA, however, various upper brainstem deficits are likely, such as hemi- or tetraparesis, diplopia, disturbance of consciousness, and facial palsy (36). Severe neurological impairment in many patients deterred us from using anticoagulants for fear of bleeding. Although the exact mechanisms of progression in this subcategory remain unclear, several researchers have indicated that these dissecting aneurysms form a spectrum of vascular abnormalities ranging from small fusiform aneurysms to symptomatic giant, so-called dolichoectatic aneurysms (23,24). When these lesions involve the BA, they may cause serious progressive brainstem compression (23).

Radiological follow up in six patients with BA dissecting aneurysm was reported to reveal spontaneous healing of the dissecting aneurysm in two, improvement in two, stability in one, and worsening in one (26). In patients with VA dissecting aneurysms, the lateral medullary syndrome is a common clinical presentation of brainstem ischemia (36). However, lesions caused by dissecting aneurysm often resolved spontaneously after endovascular treatment (17,18). Based on these experiences, we treat these lesions endovascularly to stop the dissecting process, though a therapeutic strategy for unruptured BA dissecting aneurysms has not yet been established.

In patients treated with stent-coiling, aneurysms may regrow over time, maybe due to coil compaction or the fact that the pathological process is maintained in the vessel wall (19,37). Therefore, these patients should be followed closely. Follow-up for most cases should be performed at 6-12 months if the lesion is initially treated to complete obliteration. If the occlusion is stable, it is considered cured. If there is residual aneurismal filling at the time of initial therapy, 1- to 6-month follow-up could be considered.

CONCLUSIONS

VBA dissecting aneurysms are rare lesions associated with significant morbidity and death. Endovascular stent placement with or without coiling and parent vessel occlusion could be the options for VBA dissecting aneurysms. Unruptured VBA dissecting aneurysms should also be treated to stop its progression. Regardless of treatment choice, these patients need to be followed up closely.

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