Received: 07.02.2013 / **Accepted:** 15.04.2013
DOI: 10.5137/1019-5149.JTN.8017-13.1

Treatment of Symptomatic Fusiform Aneurysm in Basilar Artery by Stenting Following Coiling Technique

Semptomatik Fuziform Baziler Arter Anevrizmaların Tedavisinde Koilleme Sonrası Stentleme Tekniği

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ABSTRACT

AIM: The present stent-assisted coil technique has many limitations especially in treating fusiform aneurysms. We aimed to introduce stenting following coiling technique to treat fusiform aneurysms.

MATERIAL and METHODS: From January 2009 to December 2010, we treated 6 patients with fusiform aneurysms in basilar artery (BA) by stenting following coiling technique. The 6 patients included four men and two women (age from 20 to 78 years, mean age 51 years). Two patients had subarachnoid hemorrhage, whereas 4 had unruptured aneurysms with progressive brainstem symptoms. In the procedure of endovascular treatment, the stent was delivered after coiling to compress the coils against the aneurysm wall and form a lumen in basilar artery.

RESULTS: Five patients had an excellent recovery with a satisfactory clinical result with an average 15.4 months follow-up. Four patients received follow-up angiographic imaging with an average 13 months, whereas 3 patients demonstrated complete aneurysm occlusion with reconstructive BA patency. Re-growth occurred in one patient, although clinically stable. None had angiographic evidence of in-stent stenosis.

CONCLUSION: Stenting following coiling technique may be a feasible and effective method to reshape parent arteries and to embolize fusiform aneurysms safely. However, this technique may be considered in selected patients.

KEYWORDS: Fusiform aneurysm, Basilar artery, Endovascular treatment, Stent

ÖZ

AMAÇ: Güncel stent yardımıyla koilleme tekniği özellikle fuziform anevrizmaların tedavisinde birçok kısıtlamalara sahiptir. Biz fuziform anevrizmaların tedavisinde, koilleme sonrası stentleme tekniğini sunmayı amaç edindik.

YÖNTEM ve GEREÇLER: Ocak 2009-Aralık 2010 arasında, baziler arterinde fusiform anevrizması olan 6 hastayı koilleme sonrası stentleme yöntemiyle tedavi ettik. 6 hastanın 4'ü erkek, 2'si kadındı (20-78 yaş arasında, ortalama yaş 51). 2 hastada subaraknoid kanama mevcutken diğer 4 hastada progresif beyin sapı semptomlarının eşlik ettiği kanamamış anevrizmaları mevcuttu. Uygulanan Endovasküler tedavi tekniği; endolümial stentin bırakılmadan, koillerin anevrizma içine konulduktan sonra, stent ile koilerin anevrizma duvarı arasında sıkıştırılıp anevrizmanın oklüde edilmesi ve ardından bırakılan stent ile baziler arterde yeni bir lümen oluşturulmasıdır.

BULGULAR: 15,4 aylık ortalama takip süresinde 5 hastada mükemmel iyileşme gözlendi. 4 hastaya ortalama 13 ay sonrasında anjiyografik kontrol yapıldığında, 3 hastanın rekonstrüktif baziler arter devamlılığı sağlanırken anevrizmaların total oklüde olduğu gösterildi. Bir hastada klinik olarak stabil olsa da nüks izlendi. olguların hiçbirinde stent içi stenoz saptanmadı.

SONUÇ: Koilleme sonrası stentleme tekniği, ana arterleri yeniden şekillendirmede ve fuziform anevrizmaları güvenli bir şekilde embolize etmede uygulanabilir ve etkili bir yöntemdir. Yine de, bu yöntem seçilmiş hastalarda uygulanmalıdır.

ANAHTAR SÖZCÜKLER: Fuziform anevrizma, Baziler arter, Endovasküler tedavi, Stent

INTRODUCTION

Endovascular treatment of intracranial aneurysms has proved to be a safe and durable method after over two decades of increased use and evaluation. The advent of stent-assisted coils in the late 1990s marked the beginning of the modern era of constructive endovascular intracranial aneurysm treatment (6). Although having different strategies of stent-assisted coils, self-expanding stent may be typically deployed prior to coil placement with the microcatheter delivered through the stent struts or prior to coil placement, with the microcatheter positioned within the aneurysm dome and wedged between the stent and the vessel wall (5, 6).

It is effective to detect and prevent coil loops herniation into parent artery in side-wall aneurysms in the traditional techniques. However, fusiform aneurysms involve the circumference of the arterial wall. When treating fusiform aneurysms assisted by stent-assisted coil, coil loops will distribute around the stents. It is difficult to determine whether coil loops have protruded into the parent artery in all angiographic projections. And coils could not pack fully and evenly around the stent. In this report, we describe six cases of fusiform aneurysms in basilar artery (BA) treated by stenting following coiling technique and evaluate the characteristics of this technique.

MATERIAL and METHODS

Patients' Population

From January 2009 to December 2010, we treated 6 patients with fusiform aneurysms in the BA by stenting following coiling technique at our hospital. The protocol was approved by the Ethics Committee of our hospital, and written informed consent was obtained from all patients or their relatives.

The six patients included four men and two women (age from 20 to 78 years, mean age 51 years). Five patients had a history of hypertension, and one also had a history of spontaneous cerebral hematoma. Six patients had seven fusiform aneurysms in BA because one patient had two separate fusiform aneurysms. Two patients had subarachnoid hemorrhage (SAH), whereas four had unruptured aneurysms. The patients with SAH were admitted with Hunt & Hess (HH) scale grade III and Fisher grade II and with HH scale grade IV and Fisher grade IV, respectively. Among the four patients with unruptured aneurysm, three presented with progressive brainstem symptoms caused by compression from a markedly elongated BA, and one had symptoms of brainstem ischemia. Diagnosis was based on clinical manifestations and findings of radiological examinations including CT scanning, MR imaging, and cerebral angiography. All patients were reviewed with respect to clinical data, serial radiological imaging, treatment, and outcome.

Technique

General anesthesia was administered for all procedures. A 6F-guiding catheter was introduced into the vertebral artery (VA) under full heparinization. We carefully navigated a self-expandable stent (Enterprise, Cordis Neurovascular, Warren, NJ) through the real lumens in BA without delivering the stent. Then we introduced another microcatheter into aneurysm sac and packed it with detachable coils. After making a partial occlusion, we delivered the stent to compress the coils against the aneurysm wall and re-construct a lumen inside the parent artery. Although the stent is positioned in the parent artery first, the delivery of the stent is following all coils deployment. We called it stenting following coiling technique.

Patients were routinely given dual antiplatelet agents (75mg clopidogrel and 100mg aspirin) for three days before operation. In acute SAH phase, the patient was given a loading dose of dual antiplatelets (clopidogrel 300mg and aspirin 300mg) through stomach tube before procedure. After surgery, the patients were monitored in the ICU before recovering from general anesthesia. The activated partial thromboplastin time (APTT) was kept 1.5-2 times normal with heparin for one day. Heparin was changed to subcutaneous injection of low molecular heparin for the next two days. Dual antiplatelet agents (75mg clopidogrel and 100mg aspirin) were given once a day orally for one month after the procedure. Then 100mg aspirin was continued for the next six months.

RESULTS

Periprocedural complication was happened in only one patient. This patient with acute SAH suffered from a thromboembolic event during procedure, but intra-arterial thrombolysis was efficient and symptoms were partially improved at a one-year follow-up (Figure 1A-F).

A follow-up neurological examination was obtained in all patients with a range of 6 to 21 months (average, 15.4 months) without any new neurological deficits. 2 patients with SAH had no re-hemorrhage during the observation period and with Glasgow outcome score (GOS) 4 and 3, respectively. The other 4 patients had no new neurological deficit and showed significant improvement in their presenting symptoms with GOS 5 in 2 patients and GOS 4 in 2 patients.

Four patients received follow-up angiographic imaging with a range of 6 to 18 months (average 13 months), whereas 3 patients demonstrated complete aneurysm occlusion with reconstructive BA patency. Re-growth occurred in one patient at one year follow-up, although clinically stable. None had angiographic evidence of in-stent stenosis.

Illustrative Cases

A 76-year-old man presented with progressive weakness of lower limbs for three months and being unable to walk for four days.

Because the lesion is more than one stent length and included two aneurysms, we used two stents and treated the distal aneurysm first. By stenting following coiling technique, we delivered stents to compress the coils around the aneurysm wall and make a patency for BA. There was part of overlapping between the two stents.

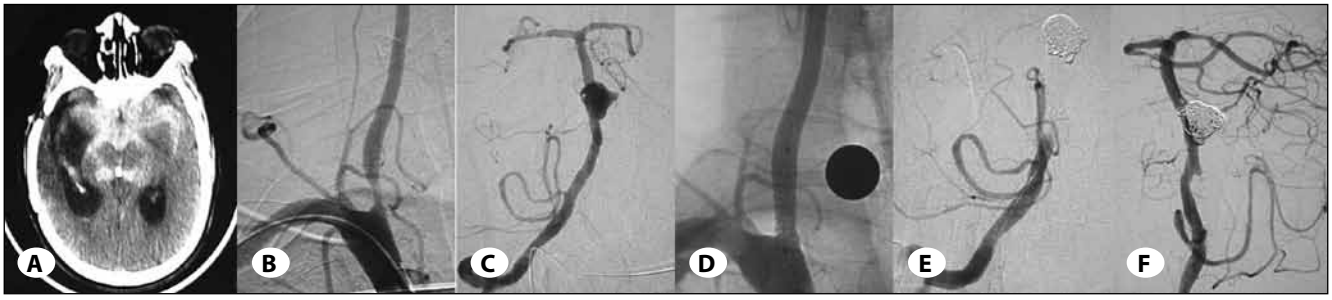

Figure 1: SAH after a second rupture **(A)**. A severe stenosis at the origin of the right VA **(B)** and an aneurysm on the middle of the BA **(C)**. Stenting the origin of the right VA **(D)**. An intraprocedure occlusion at the distal part of the BA **(E)**. Recanalization of BA after intra-arterial thrombolysis **(F)**.

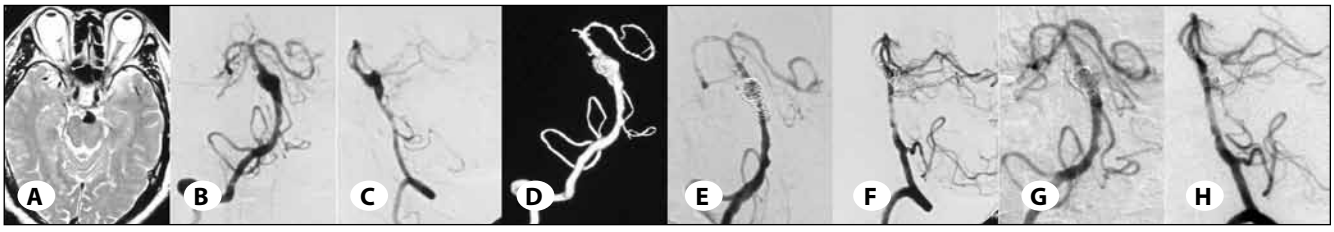

Figure 2: Dilated BA and brain stem compression in MRI **(A)**. Two fusiform aneurysms in the middle of the BA **(B-D)**. Occlusion of the fusiform aneurysms and patency of BA by stenting following coiling technique **(E-F)**. Complete occlusion of the aneurysms and the reshaped BA at 6-month follow-up angiogram **(G-H)**.

The patient was discharged after a week. He gradually recovered and had a GOS score of 5 at the 20-month follow-up. Follow-up DSA performed at the 12-month showed the reshaped BA and complete occlusion of the aneurysm (Figure 2A-H).

DISCUSSION

Fusiform Aneurysms in BA

Fusiform aneurysm is defined as a dilation involving circumference of arterial wall. It frequently occurs in the vertebrobasilar arterial trunk, and many of them originate from a dissection (13). The clinical manifestations may be SAH, ischemia or brain compression (8). In case of symptoms, many authors suggested that the patients have a high rate of re-bleeding or compression of the brain stem that worsen the patients' condition (2, 8).

Endovascular Treatment Options

Many endovascular approached may be used to treat fusiform aneurysms in BA. We took into account different treatment possibilities while selecting the unique technique for these cases. The stent-assisted coil technique is an alternative choice to treat the lesion (4, 5, 7, 13). However it was not used in our cases due to the possibility of coil protrusion into parent artery. The lesion is often around the parent artery in fusiform aneurysms. After the first coil deployment by the traditional techniques, it is difficult to judge whether further coil loops may protrude into parent arteries when placing other coils.

Occlusion of the vertebral arteries or the basilar artery is a relative simple option (4, 11); but the effect of occlusion of dominant or bilateral vertebral arteries is in doubt because persistent countercurrent flow impinges the ruptured fragile wall of the lesion. Only those patients who have sufficient collateral arteries can tolerate BA occlusion (14). Even after careful preoperative evaluation, some patients suffered from severe complications after occlusion (11). In case the entire BA or most of it has a fusiform dilation, the risk of occlusion of the entire BA is unpredictable and may be big.

A flow diverter device may be an effective option (7, 12); however it was not available in our market and the safety was not fully accepted due to the inevitable closure of the perforating branches stemming from BA. Telescopic stents without coiling technique may be an option too; however stents may be instable when the lesion is large or long. Coils may provide support to the stability of stents. Furthermore the two options should better be used in unruptured cases.

Balloon remodeling or "balloon-then-stent" method has been reported in treating intracranial aneurysms and may be another option (9, 10). A coaxial dual-lumen balloon catheter system (Scepter C balloon catheter, Microvention, Tustin, California, USA) was recently used to reduce both the number of steps involved in the technique and the opportunities for mechanical coil-related complications. If the new device could be used in our present technique, stenting following coiling technique may be easier to keep a lumen in the lesion. However, the device has not been in our market and it has not been used in fusiform aneurysms.

The last option, preferred in this case, was to place coils in aneurysms first and then deliver stent to compress the coils

around the fusiform aneurysm. By stenting following coiling technique, our aim was to avoid coil loops herniation. The stent was used to reconstruct a lumen in the parent artery and compress coils around the aneurysm to form a relatively even packing. Furthermore, the pressure that coils act on the aneurismal walls at the initial phase is low without the deployment of the stent. After the stent is deployed, it may compress coils around the aneurysm evenly. The pressure on per unit area of the abnormal wall is relatively low to decrease the risk of rupture.

There were reports about stenting after coiling, such as bailout stent deployment and stent-jack technique (1, 3, 15). The former is mainly used to prevent parent artery comprise caused by accidental prolapsed or unstable coil loops during embolization of aneurysm (15). The latter is coiling before stenting and placing additional coils after deployment of the stent in the same session. This technique is particularly suitable for the treatment of small, acutely ruptured aneurysms for which only one coil was necessary for adequate occlusion (3). There are also reports about stent deployed following complete coil occlusion performed with or without balloon remodeling. The stent is delivered across the aneurysm neck at the end of the procedure with the background idea of decreasing the recanalization rate and stabilizing coil mass (1). Our stenting following coiling technique is different from the above strategies.

What We Have Learned from Our Cases

There are two key points in this technique. The first one is to find the true lumen by judicious using of digital road-mapping to safely navigate and access the true lumen with a micro-guidewire. The second one is to make a partial coiling. Coils, especially the first coil, should be thick and 3D coils, which are looped against the wall of aneurysm sac. The size of first coil is similar to the transverse diameter of fusiform aneurysms and the length of coils should be longer. During coiling, we should evaluate the density of coils to make sure that the stents can just expand fully and compress coils to form a lumen inside. In our experience, coiling should be stopped when reaching half dense embolization.

CONCLUSION

Stenting following coiling is an alternative strategy of stent-assisted coil technique. It may be a feasible and effective method to reshape the parent artery and coil the fusiform aneurysms. However, this technique may judiciously be considered in selected patients. More cases and long-term follow-up of the technique may be necessary.

SOURCES of SUPPORT

This study was supported by the National Science Foundation of China (Grant No. 81220108007 and 81171079).

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