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Arterial occlusion to treat basilar artery dissecting aneurysm

Qing Ke Cui [a,b], Wei Dong Liu [b], Peng Liu [b], Xue Yuan Li [b], Lian Qun Zhang [b], Long Jia Ma [b], Yun Fei Ren [b], Ya Ping Wu [c,d,**], Zhi Gang Wang [a,*]

[a] Department of Neurosurgery, Qilu Hospital of Shandong University, Jinan, PR China
[b] Department of Neurosurgery, Liaocheng People's Hospital, Liaocheng, PR China
[c] Zhong Yuan Academy of Biological Medicine, Liaocheng College of Medicine, Liaocheng University, Liaocheng People Hospital, Liaocheng, PR China
[d] Department of Clinical Chemistry and Haematology, University Medical Centre Utrecht, Utrecht, The Netherlands

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ABSTRACT

Object: To explore the clinical feasibility of employing occlusion to treat basilar artery dissecting aneurysm.

Methods: One patient, male and 46 years old, suffered transient numbness and weakness on the right limbs. Cerebral angiography indicated basilar artery dissecting aneurysm. The patient underwent the stent-assisted coil embolization of aneurysm and the result is satisfactory. Digital subtraction angiography (DSA) reviews were performed at 1 month and 4.5 months, respectively after the operation and indicate that the basilar artery is unobstructed and there was no recurrence of the aneurysm. DSA review 1 year after the first treatment indicates the aneurysm recurrence, stent-assisted coils dense embolization of aneurysm was performed again and the result was satisfactory. Ten months after the second operation, DSA review found the basilar artery aneurysm recurrence again and occlusion of the basilar artery was performed.

Results: The basilar artery occlusion was effective. The bilateral posterior inferior cerebellar arteries and the bilateral posterior cerebral arteries are unobstructed. Five months of follow-up found that the patient recovered well. DSA reviews performed 5 months after occlusion indicate no recurrence of the aneurysm.

Conclusions: Occlusion to treat basilar artery dissecting aneurysm is clinically feasible, but surgical indications should be considered strictly.

* *Corresponding author at*: Department of Neurosurgery, Qilu Hospital of Shandong University, Jinan, Shandong 250012, PR China. Tel.: +86 18660139199.

** *Corresponding author at*: Zhong Yuan Academy of Biological Medicine, Liaocheng University, Liaocheng People Hospital, Medical School of Liaocheng, 67 Dong Chang Xi Lu, Liaocheng, China and University Medical Center Utrecht, Heidelberglaan 100, 3584 CX Utrecht, The Netherlands. Tel.: +86 13346258677; fax: +86 6358277306.

E-mail addresses: 455877046@qq.com (Q.K. Cui), sdlclwd@163.com (W.D. Liu), cicinec@163.com (P. Liu), doctorlixueyuan@163.com (X.Y. Li), zhanglc456@sina.com (L.Q. Zhang), 348047484@qq.com (L.J. Ma), renyunfei505@163.com (Y.F. Ren), u_m_c_u_ywu@hotmail.com (Y.P. Wu), wzg1110@126.com (Z.G. Wang).

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1. Introduction

Vertebrobasilar dissecting aneurysms (VBDA) occur at a rate of 1–1.5 per one hundred thousand individuals per year [1]. Cases restricted to the basilar artery are even rarer. At present, the strategies used to treat basilar artery dissecting aneurysms are controversial, and include pure stent implantation and stent-assisted coil embolization [2]. The treatment of artery occlusion in previous studies has mainly been by the unilateral vertebral artery occlusion to deal with pure vertebral artery dissecting aneurysm. In such cases the contralateral vertebral artery must be well developed. In this case report, we performed an occlusion of the basilar artery to treat a case of multi-recurrent basilar artery dissecting aneurysm. We present and discuss our results here. Our results indicate a satisfactory patient outcome for the duration of follow-up reported.

2. Methods and results

The patient, male and 46 years old, suffered transient numbness and weakness of the right limbs on June 26th, 2011, and recovered spontaneously 1.5 h later. The patient had a history of hypertension for more than ten years, and his blood pressure had, at one point, reached as high as 180/120 mmHg. It was being maintained at around 150/100 mmHg after six years of medication. The physical examination on admission did not show any positive features. Angiography on June 30th, 2011 indicated basilar artery dissection aneurysm. The left posterior communicating artery was bulky, and supplied blood in compensation to the bilateral posterior cerebral arteries and the brainstem area (see Fig. 1).

Before the surgical intervention, the patient took Plavix 75 mg/d, and Bayaspirin 100 mg/d orally. On July 5th, 2011, the patient underwent stent-assisted coil embolization of the basilar artery dissecting aneurysm. Prowler14 micro-tube was used to send Presidio 18 microcoil-cerecyte coil 12 mm × 40 cm micro-coil, and the framework was satisfactory. Then, a Presidio 18 microcoil-cerecyte coil 11 mm × 37 cm and a Presidio 18 microcoil-cerecyte coil 8 mm × 30 cm were placed. Angiography indicated that the distal tamponade of the aneurysm was satisfactory. After the stent was semi-released, a Presidio 10 microcoil-cerecyte coil 6 mm × 26 cm and a Presidio 10 microcoil-cerecyte coil 5 mm × 17 cm were placed. Next, the stent was released fully, and it was found that the stent covered the aneurysm neck and the narrow place. Finally, a Microplex complex 4 mm × 10 cm, a cashmere 14 microcoil-cerecyte coil 4 mm × 8 cm, and a Microplex complex 4 mm × 10 cm were placed (see Fig. 2).

The patient took Plavix and Bayaspirin as prescribed. One month after stent-assisted coil embolization, patient suffered transient numbness and weakness of the right limbs again. On August 9th, 2011, the patient returned to the hospital and underwent craniocerebral CT, which indicated no brain infarct (see Fig. 3). On August 10th, 2011, cerebral angiography showed that the basilar artery was unobstructed and that there was no recurrence of aneurysm (see Fig. 4). The patient continued to take Plavix 75 mg/d and Bayaspirin 100 mg/d, orally as prescribed. The patient recovered satisfactorily.

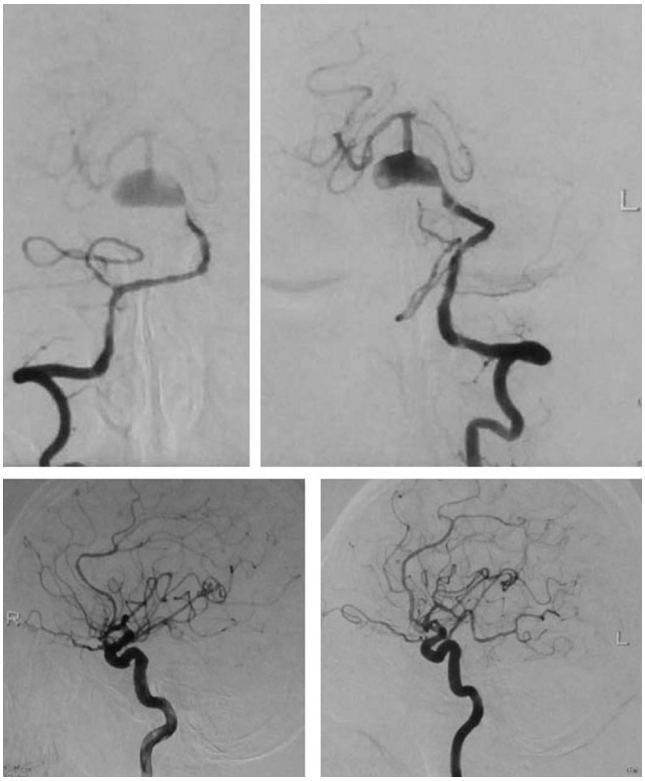

Fig. 1 – Angiography on June 2011 indicated basilar artery dissection aneurysm. The left posterior communicating artery was bulky, and supplied blood in compensation to the brainstem area. Upper left: RVA, upper right: LVA, lower left: RICA, lower right: LICA.

On November 24th, 2011, another cerebral angiography indicated that the basilar artery remained unobstructed and that there was no recurrence of aneurysm (see Fig. 5). The patient continued to take Plavix and Bayaspirin. On June 12th, 2012, a Digital Subtraction Angiography (DSA) indicated the

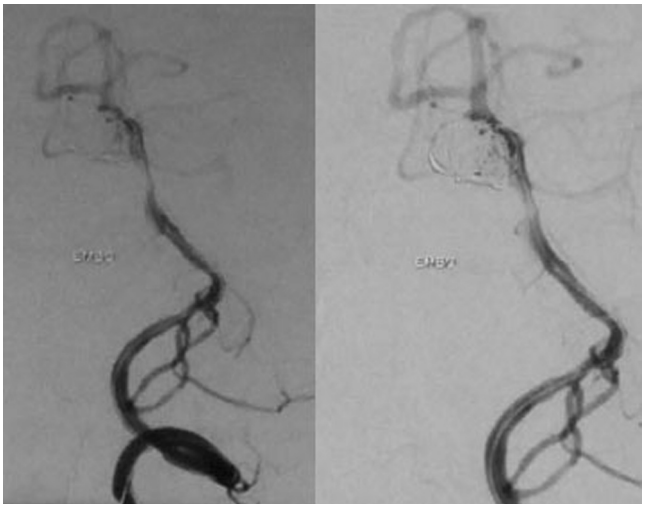

Fig. 2 – The first embolization of aneurysm by stent-assisted coils on July 2011.

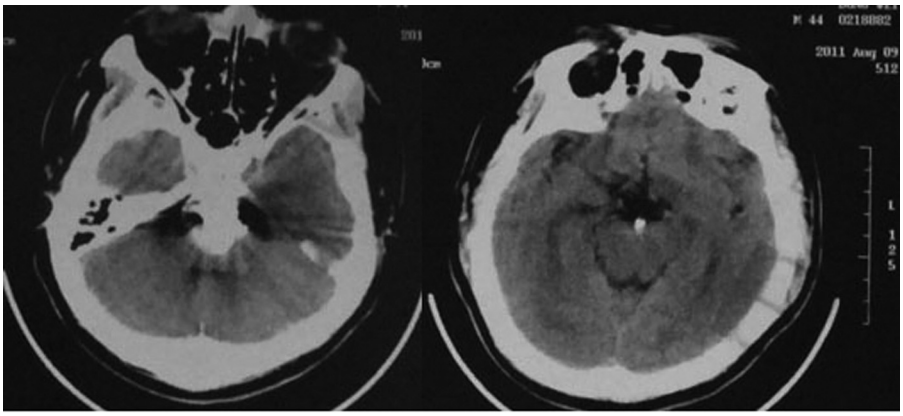

Fig. 3 – One month after embolization, the patient suffered transient numbness and weakness on the right limbs again. On August 2011, the patient came to the hospital urgently and underwent the craniocerebral CT, which indicates no brain infarct.

recurrence of the aneurysm (see Fig. 6), and the patient underwent stent-assisted coil embolization of basilar artery dissecting aneurysm for a second time. The enterprise stent was semi-released and a Presidio 10 microcoil-cerecyte coil 5 mm × 17 cm, a Jasper 5 mm × 15 cm, a Presidio 10 microcoil-cerecyte coil 4 mm × 11.5 cm, a Jasper 4 mm × 10 cm, and a Cashmere 14 microcoil-cerecyte coil 4 mm × 8 cm were used for embolization. After the aneurysm was embolized, another enterprise stent was placed, and the result was satisfactory (see Fig. 7). The patient continued to take Plavix and Bayaspirin at the prescribed dosage.

The patient suffered transient diplopia on April 6th, 2013 and transient numbness and weakness of the left limb on April 20th, 2013. On May 7th, 2013, a DSA reexamination indicated another recurrence of the aneurysm (see Fig. 8). The patient suffered transient numbness and weakness of limb repeatedly. On May 20th, 2013, with the permission of the patient and his family, occlusion of the basilar artery was performed. In the procedure we used a Presidio 10 microcoil-cerecyte coil 5 mm × 17 cm, a Micrusphere10 microcoil-platinum coil 5 mm × 9.7 cm, a Presidio 10 microcoil-cerecyte coil 4 mm × 11.5 cm, a Deltapaq10 microcoil-cerecyte coil 2 mm × 8 cm, a Deltapaq10 microcoil-cerecyte coil 1.5 mm × 4 cm, and a Deltapaq10 microcoil-cerecyte coil 1.5 mm × 4 cm to occlude the basilar artery. The basilar artery was occluded and bilateral posterior inferior cerebellar arteries were left unobstructed. The left posterior communicating artery supplied blood in compensation to the bilateral posterior cerebral arteries and the brainstem area (see Fig. 9).

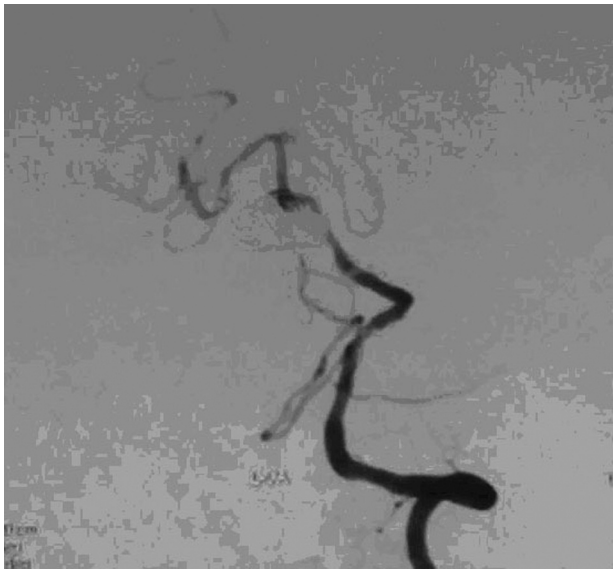

Fig. 4 – In August 2011, cerebral angiography showed the basilar artery unobstructed and no recurrence of the aneurysm. The patient recovers well. The patient continued to take Plavix 75 mg/d, Bayaspirin 100 mg/d by oral application regularly.

On May 26th, 2013, craniocerebral CT did not indicate ischemic changes in the brain parenchyma (see Fig. 10). The follow-up lasted 5 months and the patient recovered well. The brain-stem symptoms did not recur. DSA reviews performed on October 16th, 2013, 5 months after occlusion, indicate no recurrence of aneurysm and sufficient blood supply in the brain stem via collateral circulation established by the important perforating branches of the basilar artery (see Fig. 11). Craniocerebral CT performed on October 16th, 2013 did not show ischemic changes in the brain parenchyma (see Fig. 12).

3. Discussion

With the development of iconographic diagnostic techniques, the discovery and diagnosis rate of basilar artery dissecting aneurysm are higher than ever before. The high morbidity and mortality rates caused by the rupture of the aneurysm, and hemorrhage and ischemia of important areas such as the brainstem, are notable. It is therefore recommended to actively treat such aneurysms as early as possible [3–6]. Due to the specifics of the location and form of the basilar artery

Fig. 5 – On 2011, another cerebral angiography showed the basilar artery unobstructed and no recurrence of the aneurysm.

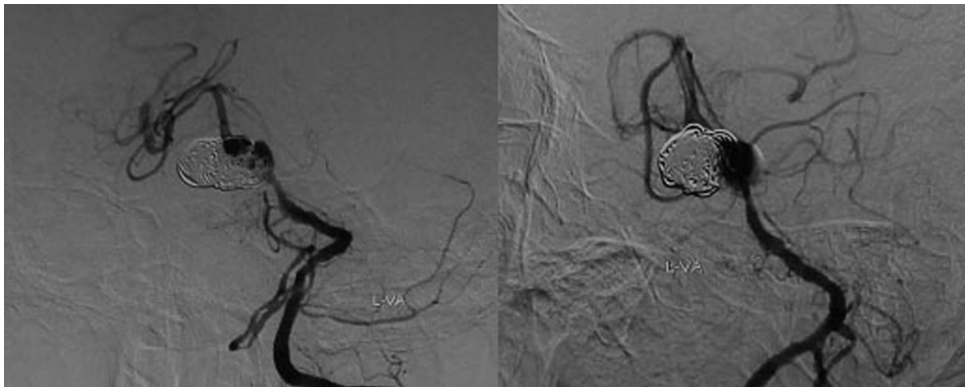

Fig. 6 – Cerebral angiogram on June 2012 indicated the recurrence of the aneurysm.

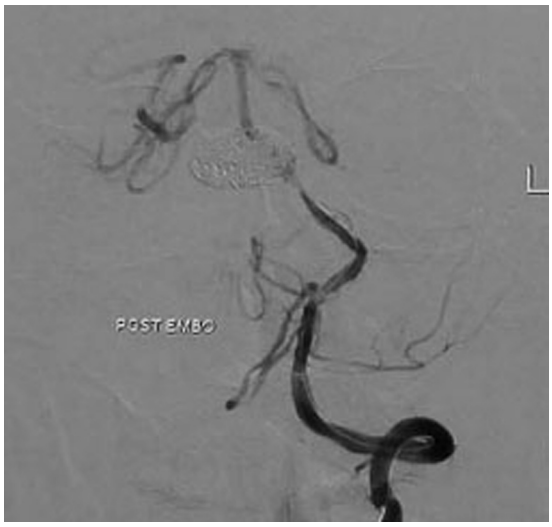

Fig. 7 – The second stent-assisted coil embolization of aneurysm was on July 2012. The enterprise stent was semi-released and sent, and after the aneurysm was embolized, another enterprise stent was placed, and the result was satisfactory.

dissecting aneurysm, as well as the possibility of the aneurysm's perforating branch, surgical intervention is highly risky and challenging. Successful cases of neurosurgical clipping have been reported, but have been infrequent [7]. Endovascular treatment is relatively safe and effective. At present, the most commonly used endovascular treatment includes stent-assisted coil embolization of the aneurysm and simple stenting [2]. The occlusion of the artery usually refers to the occlusion of the vertebral artery [8]. The occlusion of the basilar artery has rarely been reported in the literature [8,9].

The simple stenting technique was proposed by Lylyk et al. [10]. Through follow-up, Lylyk et al. collected evidence of thrombus occurring in the aneurysm of simple stenting patients. Hemodynamics in the dissecting aneurysm cavity changes after stent placement. Through the formation of thrombus in the aneurysm cavity, the hemorrhage risk of the aneurysm is reduced and the aneurysm may even be occluded. Through the stents, endothelial cells will reappear and "crawl" to repair the vascular endothelium, thus helping to heal [11]. This technique used to be the standard treatment of basilar artery dissecting aneurysm and vertebral dissecting aneurysms (VDA) on the dominant side, or VDA associated with the posterior inferior cerebellar artery [6]. Recently the use of overlapping stents [12,13] has been increasing. Compared to

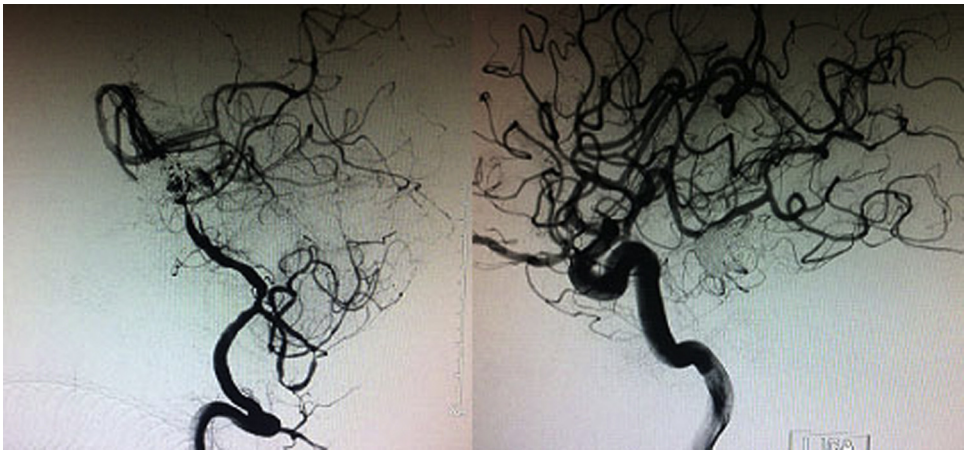

Fig. 8 – Cerebral angiogram on May 2013 and the recurrence of the aneurysm. The patient suffered transient numbness and weakness of limb repeatedly. Left: LVA, right: LICA.

simple stenting, overlapping stenting can reduce the porosity of stents and cause more prominent hemodynamic change in the aneurysm cavity, thus speeding up the formation of thrombus in the aneurysm cavity. During the procedure, angiography after stent placement indicates whether contrast agent is stranded in the aneurysm cavity and whether to place additional stents or not.

The stent-assisted coil embolization of aneurysms was proposed in 1994. The placement of stents makes a man-made neck for aneurysm to prevent the coils from intruding into the lumen of the parent artery. Through stents, this procedure makes the parent artery unobstructed and changes the hemodynamics in the aneurysm. This allows dense embolization of the aneurysm to be performed. Partial embolization can also be performed to treat the aneurysm successfully through the formation of thrombus in the cavity. The dense embolization of aneurysm is the key to prevent recurrence after the procedure. However, for dense embolization of the aneurysm cavity, it must be confirmed that there are no important perforating vessels of the basilar artery originating from the aneurysm.

The occlusion of the parent artery mainly deals with vertebral dissecting aneurysms. The prerequisite is that the contralateral vertebral artery is well developed and the blood supply of the posterior inferior cerebellar artery on the same side can be guaranteed. Through the occlusion of the parent artery, blood is prevented from flowing into the aneurysm cavity, thus preventing rehemorrhage. In the patient who is

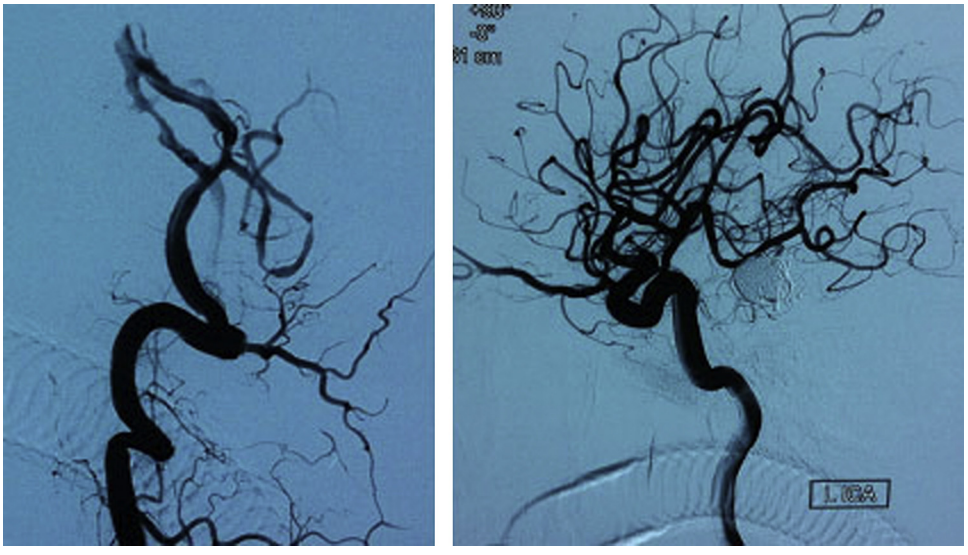

Fig. 9 – The occlusion of the parent artery-basilar artery to treat multi-recurrent basilar artery dissecting aneurysm. The MicroVention MicroPlex Coil System (MCS) complex coils establish the initial framework in the treatment. Once the initial framework has been established by one or more complex framing coils, additional MCS complex and helical coils provide filling of the basilar artery and were packed in turn to embolize the basilar artery and bilateral posterior inferior cerebellar arteries unobstructed. The left posterior communicating artery supplied blood in compensation to the bilateral posterior cerebral arteries and the brainstem area. Left: LVA, right: LICA.

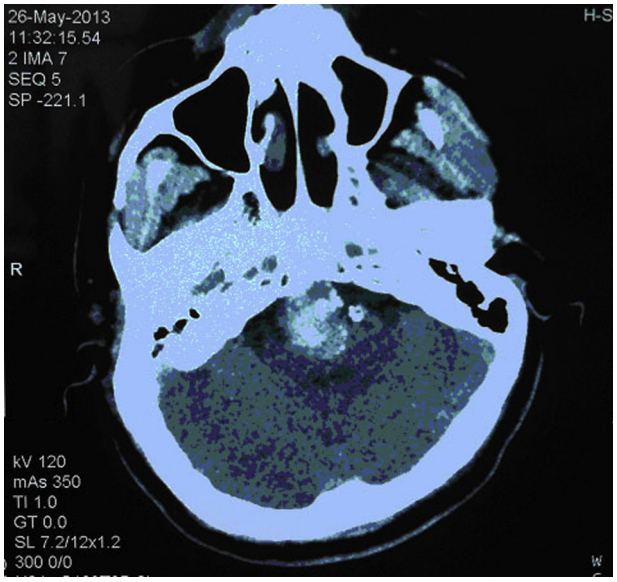

Fig. 10 – Craniocerebral CT on May 26th, 2013 indicated no parenchyma ischemic changes in the brain.

suffering from a bilateral vertebral artery hypoplasia, contralateral vertebral artery hypoplasia, involving PICA or involving basilar artery, severe complications may occur due to the deficiency of compensatory blood flow. Placing coils in the stent lumen to occlude the parent artery is a further improvement of the technique of stent placement. When the aneurysm is larger or the vessel lumen is complicated, the stents should be placed first, followed by the coils placed in the stent lumen. This will increase the stability of the placed coils and decrease the consumption of coils. The basilar artery dissecting aneurysm may press against the brainstem, even induce hemorrhage or severe dysneuria. In such cases, conservative treatment or surgical intervention does not indicate the best outcome.

In our study, the first angiography of the patient indicated that the basilar artery dissecting aneurysm was relatively large, and the left posterior communicating artery was bulky and supplied blood in compensation to the bilateral posterior cerebral arteries and the brainstem area (see Fig. 1). Simple stenting could not be used to embolize the basilar artery dissecting aneurysm immediately. In order to prevent the aneurysm from becoming larger and pressing against the brain-stem, or rupturing and hemorrhaging and threatening the patient's life, and considering that there was compensatory blood flow in the brainstem area from the left posterior communicating artery, stent-assisted coil embolization of the

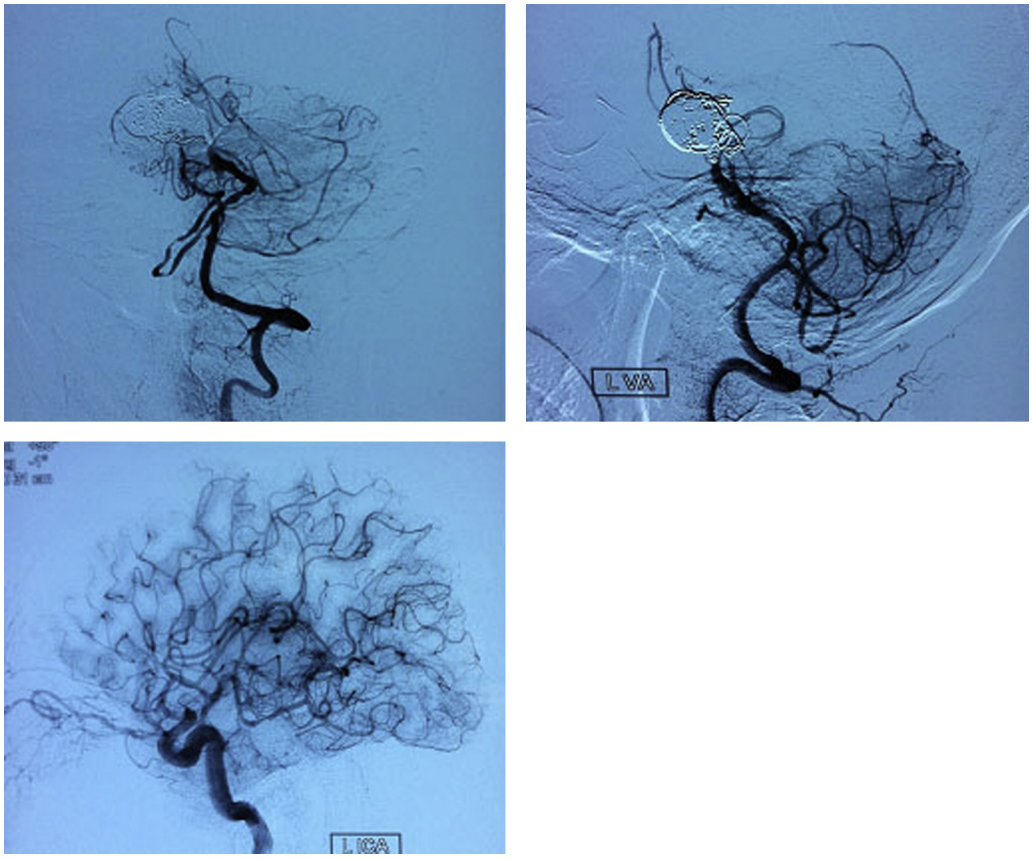

Fig. 11 – The brain-stem symptoms did not reoccur. DSA reviews performed 5 months after occlusion in October, 2013, which indicate no recurrence of the aneurysm and enough blood supply in the brain-stem by collateral circulation established for the important perforating branches of the basilar artery.

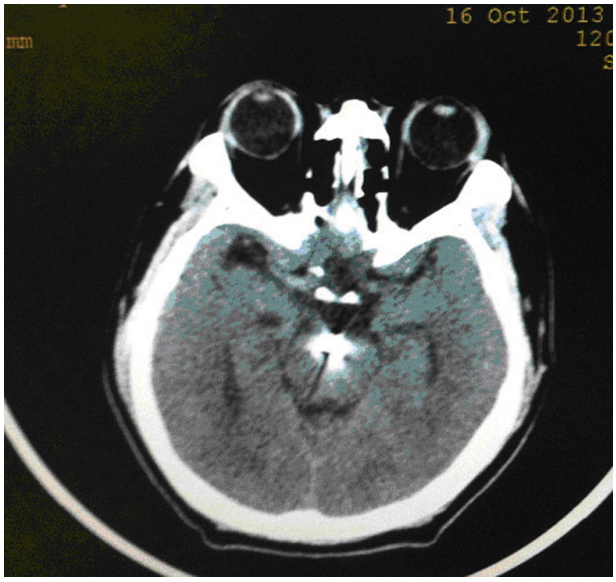

Fig. 12 – Craniocerebral CT on October 16th, 2013 indicated no parenchyma ischemic changes in the brain.

aneurysm was performed. The stent was used to make the basilar artery unobstructed, and coils were used to embolize the aneurysm cavity densely. Angiography immediately after embolization indicated a successful procedure. Although there were symptoms of intermittent ischemia after stent-assisted coil embolization, the patient's recovery was satisfactory.

One year after the first intervention, DSA reexamination indicated the recurrence of the aneurysm. In order to make the basilar artery unobstructed, stent-assisted coil embolization of aneurysm was performed again and the third enterprise stent was placed after embolization, thus achieving the effect of overlapping stents. Angiography immediately after embolization was satisfactory. However, ten months after the second procedure the DSA reexamination indicated the recurrence of the aneurysm.

At this point the following factors were taken into consideration: (1) After the placement of three overlapped stents in the basilar artery lumen, it was difficult for the microtubes to target into the aneurysm cavity. (2) A third embolization of aneurysm did not exclude the possibility of recurrence. (3) After two procedures, a significant number of coils were present in the aneurysm cavity, and the placement of additional coils may have caused the aneurysm to dilate and press against the brainstem, or caused the life-threatening rupture of the aneurysm. (4) Basilar artery dissecting aneurysm had existed in the patient for a long time and had been embolized twice. In the basilar artery lumen, three overlapped stents were placed and in the aneurysm there were a large number of coils. The patient experienced several ischemia attacks and became well spontaneously, or after treatment. This indicated that important perforating branches in the brainstem had been established. This could be evidenced by our angiography results (see Fig. 8) which show that bilateral posterior inferior cerebellar arteries developed well and the left posterior communicating artery was bulky and supplied blood in compensation to the bilateral posterior cerebral arteries and the brainstem area. (5) The basilar artery dissecting aneurysm had recurred twice. If treated conservatively, there was the possibility that the aneurysm might become larger and press against the brainstem or rupture to acute hemorrhage, thus threatening life (Fig. 8). (6) Transient diplopia and repeated transient numbness and weakness of limb may have been caused by a small quantity of hemorrhage (slight rupture of aneurysm) or enlarged aneurysm bulk (by impulsivity augmentation).

Taking the above factors into account and with the permission of the patient and his family, occlusion of the basilar artery was performed. Coils were placed in the stent lumen to occlude the basilar artery, with a view to stabilizing the placed coils. Angiography immediately after occlusion indicated basilar artery exactly occluded. The aneurysm did not visualize and the bilateral posterior inferior cerebellar arteries developed well. The left posterior communicating artery supplied blood in compensation to bilateral posterior cerebral arteries and the brainstem area (Fig. 9). Five months of follow-up found that the patient recovered well, cerebral ischemia did not occur and there were no positive features found in the nervous system examination. DSA reviews performed 5 months after occlusion indicate no recurrence of aneurysm.

Through this patient, we provide evidence that occlusion of parent artery to treat basilar artery dissecting aneurysm is clinically feasible. However, we acknowledge that one single case cannot be regarded as a basis for promoting this treatment. Studies involving more individuals and repeated follow-ups are necessary to evaluate the efficacy of this treatment modality. We maintain that the risk of occlusion of basilar artery must be evaluated strictly. There are mainly two points of surgical indications: (1) The basilar artery dissecting aneurysm has recurred, and particularly recurred repeatedly, after endovascular treatment. In such cases conservative treatment does not exclude the possibility that the aneurysm may dilate and press against the brain-stem, or that the aneurysm hemorrhages, thereby threatening life. (2) Substantial evidence must exist to show that collateral circulation is established in the important perforating branches of the basilar artery in the brainstem. It must be ensured that after occlusion there is enough blood supply in the brain-stem, and that the bilateral posterior cerebral arteries and the bilateral posterior inferior cerebellar arteries are unobstructed.

Contributors

This study was designed by WZG and CQK, with CQK also being involved in data collection and WZG for funds collection. Statistical analysis was performed by LWD and LP and data interpretation by LXY and ZLQ. WYP was responsible for the acceptance of final manuscript version and MLJ and RYF for the literature search.

Conflict of interest

None declared.

Financial support

None declared.

Ethics

The work described in this article has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans; EU Directive 2010/63/EU for animal experiments; Uniform Requirements for manuscripts submitted to Biomedical journals.

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