Flow-Diverter Stent for the Treatment of a Non-Origin Posterior Inferior Cerebellar Artery Aneurysm

A Case Report

RIYADH NASSER ALOKAILI, MUHAMMAD EJAZ AHMED

Department of Medical Imaging, King AbdulAziz Medical City National Guards Health; Riyadh, Saudi Arabia

Key words: aneurysm, endovascular treatment, flow-diverter stent, posterior inferior cerebellar artery

SUMMARY – *We describe the case of a 44-year old man with a ruptured wide-necked non-origin aneurysm of the posterior inferior cerebellar artery successfully treated with placement of a low porosity stent. To our knowledge, there are no cases in the literature of a non-origin posterior inferior cerebellar artery aneurysm treated with a flow-diverter stent.*

Introduction

Aneurysms of the posterior inferior cerebellar artery (PICA) are seldom encountered, and their management poses a therapeutic challenge. Most PICA aneurysms are located at the origin of the PICA. Distal PICA aneurysms are less common.

The surgical treatment of PICA aneurysms may not be feasible due to their deep location, anatomical considerations, and lack of expertise or the patient's condition. Therefore, the endovascular treatment of PICA aneurysms is often resorted to in such situations. Endovascular treatment options include simple coiling, stent or balloon-aided coiling, vessel sacrifice, and lately the use of low porosity stents. Each technique has its advantages. PICA preservation is desirable when feasible.

To our knowledge, only a few cases reported in the literature document the use of flow-diverting stents for PICA aneurysms^{1,2}. All such reports related to aneurysms located at the origin of the PICA.

This report describes the endovascular treatment and follow-up of a non-origin PICA aneurysm treated by a flow-diverting stent.

Case Report

A 44-year-old man presented with a four-day history of severe headache, neck pain, vomiting, and decreased level of consciousness. The patient was recently diagnosed to have hypertension but no other medical illnesses, and trauma was denied.

Examination revealed mild hypertension and a Glasgow coma scale score of 15 without any focal neurological deficit. Complete blood count, chemistry and coagulation profile were normal. Initial computed tomography (CT) of the brain showed Fisher Grade 4 subarachnoid hemorrhage. The patient was transferred to a neuro-intensive care unit and our standard subarachnoid hemorrhage medical treatment protocol started.

Cerebral angiography disclosed a wide-necked non-origin 4 mm aneurysm involving the first vertical segment of the proximal left PICA after the first turn of the vessel and before the first superior loop (Figure 1). The aneurysm was approximately one to two centimeters distal to the origin of the PICA. It projected posteriorly and towards the left. There were no other aneurysms or vasospasm. A multidisciplinary discussion (between the neu-

Figure 1 Left vertebral artery angiogram revealing a wide necked non-origin 4 mm aneurysm (arrow) involving the first vertical segment of the proximal left PICA.

Figure 2 A,B) Left vertebral artery angiogram after stent (arrows) deployment revealing patency of the parent vessel and stasis within the aneurysm sac (*).

Figure 3 Six-month follow-up left vertebral angiogram demonstrating patency of the stent and complete occlusion of the aneurysm.

reinterventional and the neurosurgical teams) followed and a consensus decision to treat this aneurysm with a low porosity stent was reached. Simple coiling was not feasible due to the wide neck. The surgical option was not pursued in view of anticipated surgical difficulty and patient's preference.

On the tenth day following hemorrhage, the patient was premedicated with 300 mg aspirin and 300 mg clopidogrel six hours before the procedure. The patient was fully anesthetized. A 5F Envoy guiding catheter (Cordis, Johnson&Johnson) was used to catheterize the left vertebral artery (VA) after administration of 3000 U bolus of IV heparin. With a Vasco 21 microcatheter (Balt, Paris, France) and a Synchro 14 micro-guidewire (Boston Scientific, USA) combination, the left PICA was selected and the microcatheter was navigated distal to the aneurysm. Subsequently a 2 mm × 15 mm Silk (Balt, Paris, France) flow-diverter stent was deployed across the aneurysm neck. The angiographic run after stent deployment revealed patency of the parent vessel and stasis within the aneurysm sac (Figure 2). No immediate complications were encountered. The patient was discharged neurologically intact after five days of observation and continued on aspirin 300 mg and clopidogrel 75 mg per day for the next six months.

The six-month follow-up angiogram demonstrated patency of the stent and complete occlusion of the aneurysm (Figure 3). Clopidogrel was withheld while aspirin was continued. A follow-up cerebral angiogram is planned after 12 months.

Discussion

Aneurysms of the PICA are rarely encountered, accounting for 0.5%-1% of all intracranial aneurysms³. Most of them arise near the origin of the PICA from the vertebral artery³. Distal PICA aneurysms are very rare, and account for approximately 0.3% of all PICA aneurysms⁴. PICA aneurysms commonly occur in patients in their fifth and sixth decades without gender predilection. The clinical presentations of ruptured PICA aneurysms are variable and include a sudden onset of severe headache (the suboccipital area in particular), mental status change, syncope, and meningeal irritation⁴.

Treatment options for aneurysms in general and PICA aneurysms in particular include surgical clipping or wrapping or alternatively endovascular interventions. The treatment of PICA aneurysms by surgical approach is technically challenging with high morbidity and mortal-

ity^{5,6}. The most important causes of the difficult surgical approach are the deep location of PICA aneurysms and the close relation to the lower cranial nerves. The bony skeleton in the region of foramen magnum and the occipital condyles also can be obstacles during surgery^{6,7}. Postoperative complications are not uncommon and include cranial nerve palsies, which are encountered in 10-45% of cases⁵, prolonged hospitalization^{5,6}, and lateral medullary syndrome⁷. Therefore, the endovascular treatment of PICA aneurysms is a valid alternative in the appropriate circumstances.

Admittedly, endovascular treatment of PICA aneurysms also faces significant challenge. The PICA has a complex, tortuous, and variable course. Endovascular options include parent vessel occlusion, simple coiling, stent or balloon-aided coiling, or placement of a low porosity stent as a standalone treatment⁷. Deconstructive techniques where parent vessel patency is not preserved ought to be left as a last resort option. With narrow neck aneurysms, coiling alone is often feasible. Wide neck aneurysms are more challenging and balloon or stent-assisted techniques can be entertained. The goal of these techniques is to occlude the aneurysm with preservation of the PICA flow⁸. Selective catheterization of the PICA may be difficult or risky because of the acute angle of the PICA in relation to the vertebral artery^{6,9}. PICA occlusion with resulting ischemia and procedural failure are well-recognized risks. The deployment of the stent into the PICA can be performed by antegrade or retrograde approach based on the angle of the PICA and the size of the neck of the aneurysm. The choice of the treatment also depends on the patency of the contralateral VA¹⁰. If the contralateral VA is wide in caliber, a contralateral and retrograde approach to the PICA might be easier than the ipsilateral antegrade approach⁸. However, retrograde stenting in conjunction with antegrade coiling of the aneurysm might be considered in the proper circumstances^{6,11}.

Since 2007, intracranial flow-diverter (FD) stents have been used in clinical practice for particular configurations of intracranial aneurysms. However, precise indications for the use of these new devices are still evolving. The aims of flow diversion are to allow the development of thrombosis within the aneurysm sac by inducing stasis by diverting the blood flow from the aneurysm sac toward the downstream artery¹².

Two flow-diverters are commercially available: the Pipeline embolization device (PED) and the SILK flow-diverter (SFD). Others are being developed by other manufactures (FRED, Microvention). The reported rate of hemorrhagic complication is higher with PED than SFD^{13,14}. A series that included of 101 intracranial aneurysms using PED found no immediate aneurysms occlusion in all patients. Due to the delay in aneurysm occlusion and the need for dual antiplatelet medication, PED treatment without coiling appears unsuitable for ruptured aneurysms in the acute phase¹⁵.

However, a recent meta-analysis of published reports of aneurysm treatment with flow diversion have demonstrated significantly lower overall rates of periprocedural and delayed complications as well as mortality with PED compared to SFD¹⁶. Specifically, the rate of ischemic complications and parent vessel occlusion are higher with SFD, and the reported mortality rate is nearly double (5% compared to 2.3%)¹⁶. Our decision to use the SFD reflects our own preference, which is based on our experience that has found SFD safer than PED in contradiction to the findings of the above mentioned meta-analysis. Moreover, coiling in conjunction with stenting in our case was not pursued due to the small caliber of the parent vessel and the anticipated increase in complexity it would add to the procedure.

Ruptured aneurysm ought to be treated at the earliest possible opportunity. However, in this particular case the ten-day delay was intentional for several reasons, but primarily due to our belief that the patency of FD stents will be jeopardized if vasospasm develops. Therefore, the typical vasospasm period is allowed to elapse before deploying FD stents in our practice.

Successful use of FD stents in small caliber vessels distal to the circle of Willis has been reported¹⁷. However, none of these reports included FD deployment in the PICA. FD deployment in the PICA is technically challenging considering the relatively more tortuous course and smaller caliber of the vessel.

To conclude, PICA aneurysms are seldom encountered. The endovascular treatment of PICA aneurysms is an increasingly utilized management option despite significant therapeutic challenges. Recent advances in endovascular techniques include FD stents, which our case illustrates can be successfully used for non-origin aneurysms in the acute phase.

References

- 1 Kulcsár Z, Ernemann U, Wetzel SG, et al. High-profile flow diverter (silk) implantation in the basilar artery: efficacy in the treatment of aneurysms and the role of the perforators. *Stroke*. 2010; 41 (8): 1690-1696. doi: 10.1161/STROKEAHA.110.580308.
- 2 Chung J, Kim BS, Lee D, et al. Vertebral artery occlusion with vertebral artery-to-posterior inferior cerebellar artery stenting for preservation of the PICA in treating ruptured vertebral artery dissection. *Acta Neurochir (Wien)*. 2010; 152 (9): 1489-1492. doi: 10.1007/s00701-010-0725-3.
- 3 Maimon S, Saraf-Lavi E, Rappaport ZH, et al. Endovascular treatment of isolated dissecting aneurysm of the posterior inferior cerebellar artery. *Am J Neuroradiol*. 2006; 27 (3): 527-532.
- 4 Park JS, Lee TH, Seo EK, et al. Aneurysms of distal posterior inferior cerebellar artery. *J Korean Neurosurg Soc*. 2008; 44 (4): 205-210. doi: 10.3340/jkns.2008.44.4.205.
- 5 Peluso JP, Van Rooij WJ, Sluzewski M, et al. Posterior inferior cerebellar artery aneurysms: incidence, clinical presentation, and outcome of endovascular treatment. *Am J Neuroradiol*. 2008; 29 (1): 86-90. doi: 10.3174/ajnr.A0758.
- 6 Roh HG, Chun YI, Choi JW, et al. Retrograde stent placement for coil embolization of a wide-necked posterior inferior cerebellar artery aneurysm. *Korean J Radiol*. 2012; 13 (4): 510-514. doi: 10.3348/kjr.2012.13.4.510.
- 7 Lva X, Jianga C, Lia Y, et al. Clinical outcomes of ruptured and unruptured vertebral artery-posterior inferior cerebellar artery complex dissecting aneurysms after endovascular embolization. *Am J Neuroradiol*. 2010; 31 (7): 1232-1235. doi: 10.3174/ajnr.A2087.
- 8 Jeon SI, Kwon BJ, Seo DH, et al. Bilateral approach for stent-assisted coiling of posterior inferior cerebellar artery aneurysms – Two cases. *J Cerebrovasc Endovasc Neurosurg*. 2012; 14 (3): 223-227. doi: 10.7461/jcen.2012.14.3.223.
- 9 Song HH, Won YD, Kim YJ, et al. The endovascular management of saccular posterior inferior cerebellar artery aneurysms. *Korean J Radiol*. 2008; 9 (5): 396-400. doi: 10.3348/kjr.2008.9.5.396.
- 10 Kim MJ, Chung J, Kim SL, et al. Stenting from the vertebral artery to the posterior inferior cerebellar artery. *Am J Neuroradiol*. 2012; 33 (2): 248-252. doi: 10.3174/ajnr.A2741.
- 11 Zaidat OO, Szeder V, Alexander MJ. Transbrachial stent-assisted coil embolization of right posterior inferior cerebellar artery aneurysm: technical case report. *J Neuroimaging*. 2007; 17 (4): 344-347. doi: 10.1111/j.1552-6569.2007.00115.x.
- 12 Berge J, Biondi A, Machi P, et al. Flow-diverter Silk stent for the treatment of intracranial aneurysms: 1-year follow-up in a multicenter study. *Am J Neuroradiol*. 2012; 33 (6): 1150-1155. doi: 10.3174/ajnr.A2907.
- 13 Wong GK, Kwan MC, Ng RY, et al. Flow diverters for treatment of intracranial aneurysms: current status and ongoing clinical trials. *J Clin Neurosci*. 2011; 18 (6): 737-740. doi: 10.1016/j.jocn.2010.10.011.
- 14 Byrne JV, Szikora I. Flow diverters in the management of intracranial aneurysms: a review. *EJMINT*. 2012; 12225000057.
- 15 Fischer S, Vajda Z, Aguilar Perez M, et al. Pipeline embolization device (PED) for neurovascular reconstruction: initial experience in the treatment of 101 intracranial aneurysms and dissections. *Neuroradiology*. 2012; 54 (4): 369-382. doi: 10.1007/s00234-011-0948-x.
- 16 Murthy SB, Shah S, Shastri A, et al. The SILK flow diverter in the treatment of intracranial aneurysms. *J Clin Neurosci*. 2014; 21 (2): 203-206. doi: 10.1016/j.jocn.2013.07.006.
- 17 Pistocchi S, Blanc R, Bartolini B, et al. Flow diverters at and beyond the level of the circle of Willis for the treatment of intracranial aneurysms. *Stroke*. 2012; 43 (4): 1032-1038. doi: 10.1161/STROKEAHA.111.636019.

Muhammad Ejaz Ahmed, MBBS, FRCR
 Consultant Neuroradiologist
 Department of Medical Imaging
 King AbdulAziz Medical City
 National Guards Health Affairs
 Mail Code 1222, P.O. Box 22490
 Riyadh 11426
 Saudi Arabia
 Tel.: +966508909923
 E-mail: drejaz01@hotmail.com