Access this article online

Quick Response Code:

Website: http://www.braincirculation.org

DOI: 10.4103/bc.bc_71_20

Stent-in-stent technique for the management of blood blister-like basilar apex aneurysms

Tarun Prabhala, Pouya Entezami, Junichi Yamamoto

Abstract:

Blood blister-like basilar apex aneurysms are rare thin-walled vascular lesions with a poorly defined aneurysmal neck. We present two patients with ruptured blister aneurysms of the basilar apex who were treated using the stent-in-stent technique. Long-term follow-up showed persistent and complete occlusion of the aneurysms without radiographically or neurological complications. There is no optimal treatment of choice for the basilar apex blood blister-like aneurysms. Double- or triple-stent placement using the stent-in-stent technique can be a safe and feasible option for these uncommon and challenging intracranial aneurysms.

Keywords:

Aneurysm embolization, blood blister-like aneurysms, endovascular therapy, stent-in-stent

Introduction

Blood blister-like aneurysms (BBAs) account for 0.3%–1% of all intracranial aneurysms.[1] BBAs are thin-walled vascular lesions with a poorly defined aneurysmal neck which – unlike traditional saccular aneurysms – and typically do not arise at arterial branching points.[2] Consequently, they provide a unique challenge for management, often requiring multiple treatments complicated with a high incidence of rebleeding, particularly in the posterior circulation.[1] We present two patients with ruptured BBAs who received endovascular treatment using the stent-in-stent approach.

Case Reports

Case #1

A 52-year-old woman presented with a Hunt and Hess (HH) Grade 2 subarachnoid hemorrhage. Initial computed tomography (CT) angiography was negative, but a diagnostic cerebral angiogram revealed a 1.7 mm by 1.6 mm BBA at the ventral aspect of the basilar bifurcation. Neither coil nor stent-assisted coil embolizations were indicated due to the aneurysm morphology and anticipated high risk of intraoperative rupture. Flow diversion and microsurgery were less favorable options secondary to the perforating arteries around the basilar bifurcation.

As an alternative, two Low-Profile Visualized Intraluminal Support (LVIS) Jr. stents (MicroVention-Terumo, Tustin, CA, USA) were placed using the stent-in-stent technique, with one stent measuring 3.5 mm × 23 mm and the other 3.5 mm × 18 mm. We slightly oversized the stents to reduce the cell size between the stent tines, expecting a slightly increased flow-diverting effect. The first stent was deployed from the left P1 segment of the posterior cerebral artery (PCA) to the basilar artery. The second LVIS Jr. was deployed within the first stent.

Department of Neurosurgery, Albany Medical Center, Albany, NY, USA

Address for correspondence:
Dr. Junichi Yamamoto, Albany Medical Center, 47 New Scotland Ave, MC-10, Albany, NY, USA.
E-mail: yamamoj@amc.edu

Submission: 10-12-2020
Revised: 01-04-2021
Accepted: 09-04-2021
Published: 29-05-2021

How to cite this article: Prabhala T, Entezami P, Yamamoto J. Stent-in-stent technique for the management of blood blister-like basilar apex aneurysms. Brain Circ 2021;7:128-31.

The patient had no focal neurological symptoms at 3-month follow-up. However, while initial interval imaging at 1 month showed a reduction in aneurysm size, CT angiography at 4 months demonstrated a small recurrent aneurysm [Figure 1]. A third stent – 4.5 mm × 22 mm Enterprise (Codman Neurovascular, Raynham, MA, USA) – was placed in a telescoping fashion to the other stents. Angiogram 3 months later showed complete resolution of the lesion. Interval CT angiograms at 1, 2, and 3 years postoperatively did not demonstrate any recurrence.

Case #2

A 66-year-old woman presented with a HH Grade 4 diffuse subarachnoid hemorrhage. CT angiogram and diagnostic cerebral angiography on admission were negative. The patient required placement of a right external ventricular drain for hydrocephalus. Repeat diagnostic cerebral angiography on day 8 with three-dimensional reconstructed images demonstrated a BBA at the dorsal aspect of the basilar apex [Figure 2]. A Neuroform EZ stent (Stryker Neurovascular, Fremont, CA, USA) measuring 4.5 mm × 20 mm and a 4.5 mm × 22 mm Enterprise were placed in telescoping fashion from the right PCA to the upper basilar artery.

Despite transient short-term memory loss on presentation, the patient improved and had no focal neurological deficits by 3-month follow-up. CT angiogram obtained at 6 months revealed complete obliteration of the aneurysm, and interval scans at 1, 2, 4, and 7 years postoperatively remained stable.

Discussion

An estimated 1%–5% of adults have a cerebral aneurysm associated with a >50% morbidity and mortality rate if ruptured.[3] Saccular cerebral aneurysms are primarily located at arterial bifurcation apices due to dynamic interplay between pressure gradients and wall shear stress.[4] BBAs are a subtype with small size, fragile walls, and a poorly defined broad-based neck.[2] Despite poorly understood pathophysiology, current investigations suggest that BBAs primarily originate from dissections.[4] Their fragility is due to thinned adventitia overlying underlying defects in the intima and media, and there is a strong association between these aneurysms and arteriovenous malformations. Atherosclerosis and hemodynamic stress elevate propensity toward BBA rupture.[5-7]

Endovascular techniques for aneurysm embolization include coil embolization, stent-assisted coil embolization, and flow diversion.[8] Due to their anatomical depth, proximity to integral structures, and important nearby perforating arteries, basilar apex BBAs pose significant complexity in management. Historically, basilar apex aneurysms were managed using microsurgical clipping.[5,9] However, recent advancements have shifted management toward endovascular therapy. Similarly, basilar apex BBAs are less amenable to microsurgical clipping due to their broad-based necks.[10]

Flow diversion utilizes a stent placed in the parent artery to decrease laminar flow to the aneurysmal sac, stimulating thrombotic occlusion while promoting vascular remodeling and improving blood flow to adjacent branches.[8] This has been associated with higher technical success rates and similar clinical outcomes compared to other methods. Delayed aneurysm occlusion (especially postrupture) and antiplatelet therapy requirements remain drawbacks to flow diversion.

While flow diversion has had good results in treating posterior circulation aneurysms, a higher mortality rate and worse outcomes have been reported with flow diversion for ruptured basilar artery aneurysms. Similarly, posterior circulation BBAs have a more robust risk profile compared to the anterior circulation cohort.[11] Due to the rich density of perforator arteries within the basilar artery, there is a higher risk for infarction

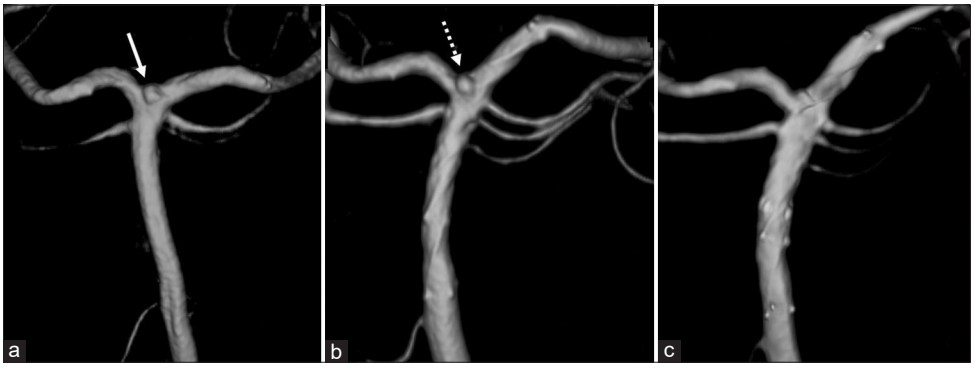

Figure 1: Three-dimensional reconstructed images from digital subtraction angiography images taken in the anteroposterior plane for patient 1. Initial imaging (a) shows a blood blister-like aneurysm arising from the basilar apex (solid arrow); (b) Fourth month posttreatment with two Low-profile Visualized Intraluminal Support Jr. stents, a recurrence can be seen (dashed arrow); this is resolved on (c) 3-month interval imaging after placing a third stent (Enterprise)

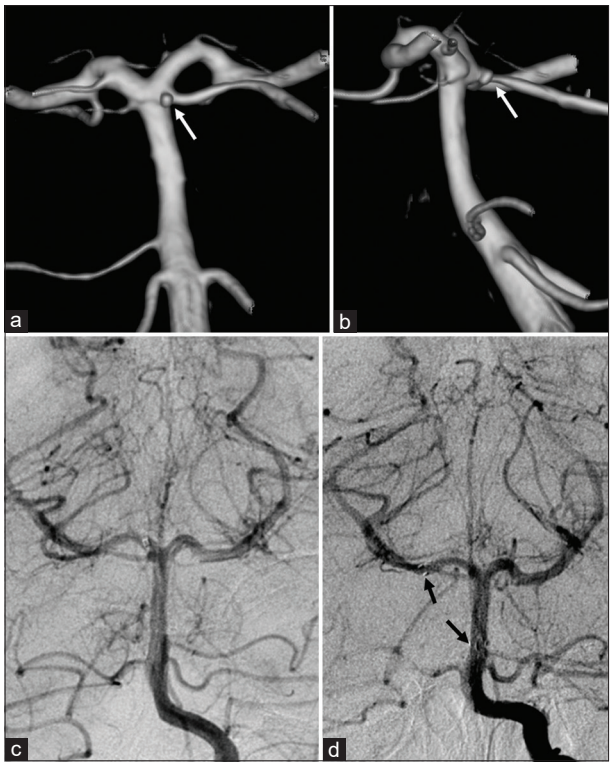

Figure 2: Three-dimensional reconstructed images from digital subtraction angiography images for patient 2, showing (a) anteroposterior and (b) lateral views of a small blister-like aneurysm arising from the posterior wall of the basilar apex (white arrows). Angiographic images in anteroposterior (c) pre- and (d) post-stent placement (black arrows)

with flow diversion. In addition, flow diversion has been shown to complicate vasospasm management in patients with ruptured BBAs. Posterior circulation flow diversion is also associated with an increased risk for thromboembolic events in larger reviews.[11] Ultimately, flow diverter placement is not a definitive treatment option for basilar artery BBAs despite their high rate of complete occlusion and good outcomes in other aneurysm types, and must be used judiciously.

The stent-in-stent technique is an endovascular approach in the management of aneurysms through the placement of stents in a telescoping fashion. Studies have shown that flow-diverting stents cause more flow reduction than two traditional stents.[12,13] One retrospective review involving six patients investigated this technique in the treatment of supraclinoid internal carotid artery BBAs, with 50% of patients having no residual or recurrent aneurysm with stents alone (the rest requiring retreatment with coils). Five patients had good recovery.[14] Another study investigated the hemodynamic alterations resulting from stent-in-stent placement across a giant fusiform aneurysm of the vertebrobasilar junction. The authors achieved a flow reduction of 86% and improved thrombogenic conditions. Assessment of computed velocity streamlines of the stent-in-stent configuration showed markedly reduced intra-aneurysmal flow velocity. This orientation markedly decreases flow into the aneurysmal sac, reduces the porosity of the stent construct, enhances flow diversion, and promotes intraluminal thrombosis compared to a single stent.[15] Thus, it is possible to treat aneurysms with two traditional (nondiverting) stents, while potentially reducing the risk to the perforating arteries.

Conclusion

In our cases, the stent-in-stent technique was utilized for basilar apex BBAs. Both patients tolerated the procedure well, neither exhibiting any long-term neurological deficits. One patient's course was complicated by minor enlargement of the aneurysm that was subsequently repaired through the placement of a third stent. Otherwise, both remained well treated over time without clinical evidence of perforating artery injuries.

This technique serves as a safe alternative to flow diversion or microsurgical clipping therapeutic strategies for basilar artery blister aneurysms in select patients. The patients presented in this study are the first reported posterior circulation BBAs successfully treated using this method. Surveillance imaging is crucial following this procedure to monitor aneurysmal recurrence.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Peschillo S, Cannizzaro D, Caporlingua A, Missori P. A systematic review and meta-analysis of treatment and outcome of blister-like aneurysms. AJNR Am J Neuroradiol 2016;37:856-61.
2. Nishikawa H, Shimizu S, Nakajima H, Kitano Y, Sano T, Mouri G, *et al.* Characteristics of blood blister-like aneurysms with a saccular-shape appearance. World Neurosurg 2017;108:595-602.
3. King JT Jr. Epidemiology of aneurysmal subarachnoid hemorrhage. Neuroimaging Clin N Am 1997;7:659-68.
4. Gonzalez AM, Narata AP, Yilmaz H, Bijlenga P, Radovanovic I, Schaller K, *et al.* Blood blister-like aneurysms: Single center experience and systematic literature review. Eur J Radiol 2014;83:197-205.
5. Mooney MA, Kalani MY, Nakaji P, Albuquerque FC,

McDougall CG, Spetzler RF, *et al.* Long-term patient outcomes after microsurgical treatment of blister-like aneurysms of the basilar artery. Neurosurgery 2015;11 Suppl 3:387-93.
6. Umana GE, Spitaleri A, Fricia M, Indorato I, Nicoletti GF, Cicero S, *et al.* Diffuse cerebral angiomatosis associated to basilar apex aneurysm. Br J Neurosurg 2020;1-5. [doi: 10.1080/02688697.2020.1836324].
7. Mitha AP, Spetzler RF. Blister-like aneurysms: An enigma of cerebrovascular surgery. World Neurosurg 2010;74:444-5.
8. Wong GK, Kwan MC, Ng RY, Yu SC, Poon WS. Flow diverters for treatment of intracranial aneurysms: Current status and ongoing clinical trials. J Clin Neurosci 2011;18:737-40.
9. Almefty RO, Spetzler RF. Microsurgical clipping of a blister-like basilar tip aneurysm: 2-dimensional operative video. Oper Neurosurg (Hagerstown) 2018;14:593-4.
10. Peitz GW, Sy CA, Grandhi R. Endovascular treatment of blister aneurysms. Neurosurg Focus 2017;42:E12.
11. Wang CB, Shi WW, Zhang GX, Lu HC, Ma J. Flow diverter treatment of posterior circulation aneurysms. A meta-analysis. Neuroradiology 2016;58:391-400.
12. Wang C, Tian Z, Liu J, Jing L, Paliwal N, Wang S, *et al.* Flow diverter effect of LVIS stent on cerebral aneurysm hemodynamics: A comparison with Enterprise stents and the Pipeline device. J Transl Med 2016;14:199.
13. Roszelle BN, Gonzalez LF, Babiker MH, Ryan J, Albuquerque FC, Frakes DH. Flow diverter effect on cerebral aneurysm hemodynamics: An *in vitro* comparison of telescoping stents and the Pipeline. Neuroradiology 2013;55:751-8.
14. Gaughen JR Jr., Hasan D, Dumont AS, Jensen ME, McKenzie J, Evans AJ. The efficacy of endovascular stenting in the treatment of supraclinoid internal carotid artery blister aneurysms using a stent-in-stent technique. AJNR Am J Neuroradiol 2010;31:1132-8.
15. Sindeev S, Kirschke JS, Prothmann S, Frolov S, Liepsch D, Berg P, *et al.* Evaluation of flow changes after telescopic stenting of a giant fusiform aneurysm of the vertebrobasilar junction. Biomed Eng Online 2019;18:82.