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Technical Note

Ruptured Bilobed Basilar Artery Fenestration Aneurysm Treated with a WEB Device

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Objective: To describe the technique of using a Woven Endo Bridge (WEB) device to treat a ruptured bilobed blister-like aneurysm (BLA) at the basilar artery (BA) fenestration.

Case Presentation: A previously healthy 66-year-old female presented at the emergency room with subarachnoid hemorrhage (SAH), centered around the brainstem. Unenhanced CT and CT angiography showed a BLA of a basilar fenestration limb. The angiogram confirmed the diagnosis. A WEB device was chosen to treat this rare and challenging aneurysm.

Conclusion: In this article, we describe the successful endovascular treatment of a SAH patient with a ruptured BLA at the basilar artery fenestration using a WEB device. And an overview of treatment options is provided.

Keywords ▶ blister-like aneurysm, treatment, WEB device, subarachnoid hemorrhage

Introduction

Blister-like aneurysms (BLAs) were first described by Nakagawa in 1986.[1)] Of all intracranial aneurysms, 0.3%–2% are described to be of blister-like type.[2)] BLAs are small sidewall lesions that arise from nonbranched arteries and can grow in many sites. Most often they are observed at the supraclinoid internal carotid artery (ICA). The wall just contains a layer of adventitia which is also part of the reason why rerupture rates are high and until recently most were fatal.[3)] BLAs are increasingly diagnosed on CT angiography due to better understanding of pathology and advancing DSA technique, although these aneurysms are still a diagnostic as well as a therapeutic challenge.

In literature, different treatment techniques and options are described including surgery, endovascular therapy, or a combination of the two. Endovascular treatment has recently shown to have lower mortality rates than surgical treatment.[4)] Especially, flow-diverting stents are a promising treatment, but on the contrary, a dual antiplatelet regimen associated with hemorrhagic complications is needed. To date, the optimal way of treating these challenging aneurysms has not yet been defined.[5)]

In this technical report, we describe a patient with a subarachnoid hemorrhage (SAH) due to a ruptured bilobed BLA of a basilary fenestration who was successfully treated using a Woven Endo Bridge (WEB) device. Moreover, we will provide an overview of alternative endovascular treatment options for BLAs.

Case Presentation

A previously healthy 66-year-old female presented at the emergency room with a SAH, centered around the brainstem. She woke up with a headache and nausea but had no neurological deficits. An unenhanced CT and CT angiography were performed and showed a 2-mm-sized BLA of a basilar fenestration limb on the right side. An angiogram was performed, which confirmed the diagnosis (**Fig. 1**). After an agreement in a multi-disciplinary meeting, it was decided to treat the patient endovascularly with a WEB device.

Three days after presentation, the endovascular treatment was performed. A 6 French Arrow sheath (Teleflex) was placed in the left vertebral artery and a distal access catheter (DAC) Sophia (6 French) was placed in the left

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Fig. 1 Angiography of the bilobed BLA pre-treatment. BLA: blister-like aneurysm

Fig. 2 3D image of the bilobed aneurysm pre-treatment.

distal vertebral artery. Heparin 3000 IU was administered. anteroposterior (AP), lateral, and 3D rotational images were performed and showed a 4-mm bilobed BLA on the right limb of the fenestration with the right anterior inferior cerebellar artery (AICA) originating directly above the fenestration limb (**Fig. 2**). A diagnostic 4 French catheter was placed in the right vertebral artery. Using a Via (0.021) microcatheter and Traxcess guide wire, the right branch of the fenestration was selectively catheterized. The right limb of the fenestration measured 3 × 5 mm with the bilobar blister aneurysm extending from proximal to distal end of the limb; therefore, it was risky to place a stent and trap the coiling catheter behind the stent due to the size of and the fragile nature of this bilobar aneurysm. Placing a flow diverter (FD) was considered but again due to the short length of the limb, there was no suitable FD available. Longer FDs were not appropriate due to high risk of ischemic complication (covering the perforators and the AICA). A WEB device was chosen in this specific case because of a short limb and the small size of the fenestration of the limb which made treatment via stent-assisted coiling or placing a FD not feasible. A WEB device was introduced. The WEB (SLS 4; 4 mm × 2.6 mm) was placed in the right limb of the fenestration just caudally of the AICA (**Fig. 3**). Angiography before the detachment of the WEB device showed no flow limitation through the left limb of the fenestration (**Fig. 4**). We chose to occlude the right fenestration limb despite the possible risk of jeopardizing the perforator originating from that limb. Coiling of this limb was also considered but was in our opinion a less suitable treatment option because of the risk of basilar artery (BA) occlusion due to coil displacement, migration, or thrombo-embolism. Therefore, the smallest WEB device was chosen to occlude the fenestration limb which involved the BLA. The mechanical stress of the WEB device was on the limb and not on the aneurysm itself which was considered safe. Control angiography showed no flow in the BLA and the right limb of the basilary

Fig. 3 Angiography of WEB device, SS type, and placement.

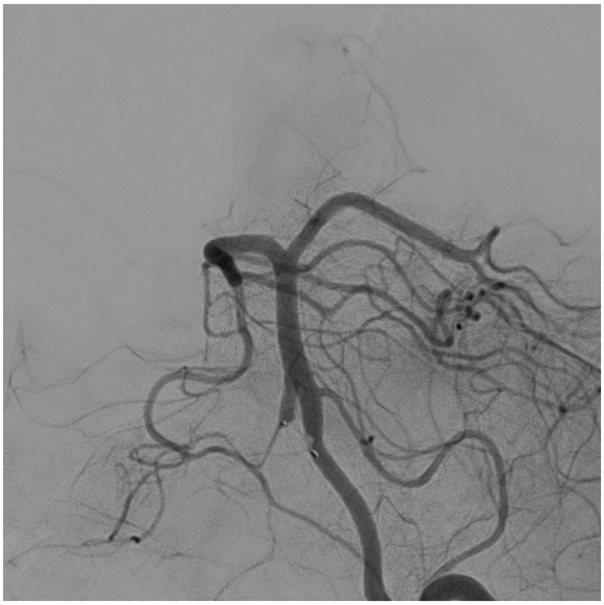

Fig. 4 Final angiogram of the bilobed BLA with WEB device in situ. BLA: blister-like aneurysm; WEB: Woven Endo Bridge

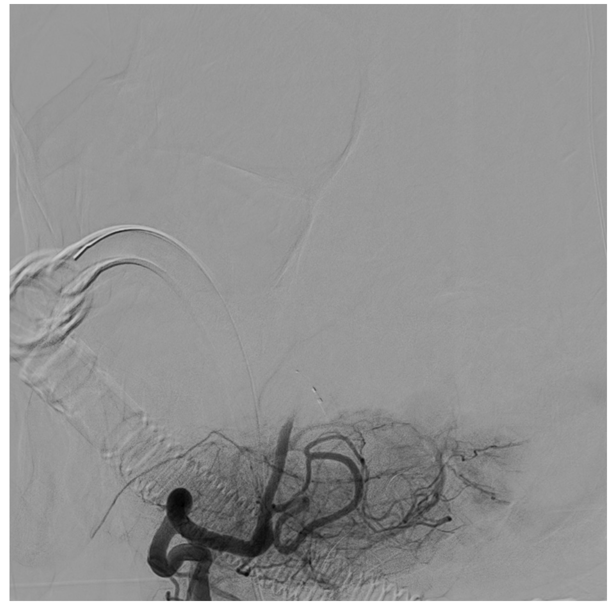

Fig. 5 VA angiogram of the right VA after the placement of the WEB. WEB: Woven Endo Bridge

fenestration. The angiogram showed good flow from the right verterbral artery (VA) to the right posterior inferior cerebellar artery (PICA) (**Fig. 5**). The left limb of the basilar fenestration was open and showed no flow limitation to the BA and its branches, including the right AICA. The patient was afterwards treated with aspirin for 3 months. On an MRI scan 3 months after treatment, the embolized BLA with the WEB device in situ showed no recanalization. The patient had a good clinical outcome (modified Rankin Scale [mRS] of 1) at follow-up.

No brainstem infarct occurred until now.

Discussion

Blister-like aneurysms

Literature on BLAs is limited as the incidence is low. Most BLAs are found at the supraclinoid ICA, but they can occur in any cerebral artery typically from nonbranching sites. The underlying mechanisms of BLA formation include hypertension, atherosclerosis, and pseudoaneurysms due to arterial dissection. Ishikawa et al.[6] performed an autopsy of a patient with a BLA in the ICA showing that this aneurysm developed in an area where sclerotic vessel walls transitioned into the normal carotid wall. The authors suggest that these aneurysms might be a subtype of dissecting aneurysms or pseudoaneurysms. This is based on the degeneration found in their case and the internal elastic lamina that was found in association with lack of normal adventitia and fibrinous tissue. Peschillo et al.[4] studied atypical locations of BLAs and found an incidence in the anterior communicating artery (ACoA) of 34.6%, in the middle cerebral artery (MCA) of 23 % and the BA of just 19.2%.

Fenestration Aneurysms

A vascular fenestration is a partial duplication, or luminal division, within a vessel segment that results in two distinct endothelium-lined channels with surrounding tunica muscularis. Basilary artery fenestrations are the most common intracranial fenestration, which might be explained by failed fusion of primitive longitudinal neural arteries.[7] They are most often located in the proximal basilar trunk or extracranial segments of the vertebral artery. Commonly BLAs are associated with other vascular abnormalities, especially other cerebral aneurysms or arteriovenous malformations.[8,9] Fenestrations in general are notorious for iatrogenic injuries during endovascular intervention as they are exceptionally vulnerable.

Endovascular techniques in BLAs

Treatment of BLAs is challenging and the optimal treatment has yet to be defined. The treatment options for BLAs are microsurgery, endovascular therapy, or a combination. Peshillo et al.[4] studied BLAs at atypical locations and found that surgical treatment was chosen in 65% of patients, endovascular approach was used in 30%, and a combined approach was used in 5%. A good outcome was experienced by, respectively, 88% and 55% of the patients in the endovascular and surgical groups.

Surgical options are direct aneurysm clipping with or without protective bypass, clip-wrapping, or trap ligation with or without a bypass. The rates of intraoperative and postoperative rebleeding range from 33% to 80% in most studies.

Endovascular treatment options mentioned in literature are mainly main vessel occlusion, stenting with or without coiling, covered stents, or FDs. Historically, endovascular main vessel occlusion has often been reported in treatment in BLAs of the ICA. Kim et al.[10] performed endovascular ICA occlusion in seven patients as primary treatment and in four patients as a secondary treatment. In the primary ICA occlusion group, one patient died and in the secondary ICA trapping group, two patients had poor outcomes (mRS 4 and 5).

Coiling and stents are often not suitable for BLAs because of the small size and broad base of these aneurysms. These treatment options can cause perforation and rebleed. The effectiveness also remains controversial and therefore just a few published cases can be found.[11] Stent-assisted coiling facilitates placement of coils but is associated with low occlusion rates; 33% initially and around 70% at mid- to long-term follow-up, with a retreatment rate of 27%.[11] Fang et al.[12] evaluated the safety and feasibility of a covered stent in 13 patients with a ruptured BLA of the ICA. Complete aneurysm occlusion was confirmed during DSA in 12 of 13 patients. Occlusion of the ophthalmic artery (OA) occurred in two patients and occlusion of the anterior choroidal artery (AChoA) in one patient. Angiographic follow-up after 4–6 months showed complete occlusion without any aneurysm recurrences, indicating covered stents might offer a therapeutic option for ICA BLAs.

Flow-diverting stents are a promising treatment option as they are purely for endoluminal arterial reconstruction. Linfante et al.[5] treated SAH patients due to BLAs successfully with Pipeline stents (8 ICA and 2 MCA). All lesions were very small (mean 1.4 × 1.5 mm). Placement of one PED resulted in immediate (near) occlusion in 9 of 10 patients. Eight patients had a 90-day mRS score of 0 and one had a 90-day mRS score of 1, there was complete occlusion of the BLA on long-term follow-up angiography after 15 months. Aydin et al.[13] obtained complete occlusion in 11 patients (9 ICA and 2 basilar arteries) using implantation of SILK stents. A low initial occlusion rate (36%) is described with a significant procedural complication rate (17%), early rebleed (7%), morbidity (13%), and mortality (9%). Another disadvantage is the after treatment with antiplatelet therapy in the acute phase. A recent meta-analysis showed that flow-diverting stents carry a lower retreatment rate and a higher occlusion rate than non-flow-diverter reconstructive techniques (coiling, stent-assisted coiling, or overlapped stents), also after long-term follow-up.[14]

WEB device

WEB devices are registered for adult patients with aneurysms in the MCA bifurcation, ICA terminus, ACoA complex, or BA apex. A WEB device is indicated to embolize intracranial aneurysms with saccular, wide neck, or bifurcation with a diameter ranging from 3 to 10 mm, a neck size of 4 mm or greater, or a dome-to-neck ratio >1 mm and <2 mm.

For these indications, a systematic review was written by van Rooij et al.[14] using 15 articles. The overall rate of adequate aneurysm occlusion was 83.3% in typical berry aneurysms. A procedural aneurysm rupture rate of 8 of 963 patients (1%) was reported. In 54 of the 963 patients (6%), a thromboembolic event was reported. The cumulative mortality found was 1%. Retreatment was reported in 38 aneurysms of 450 aneurysms.

Off-label use of WEB devices has been reported by Zanaty et al.[15] on 11 patients with 12 aneurysms. The locations of the BLAs included the posterior communicating artery, supraclinoid and cavernous segments of the ICA, the pericallosal artery, the posterior inferior cerebellar artery, and at the vertebrobasilar junction. The aneurysms had an average size of 2.5 mm. Postprocedural occlusion was complete in four (33.3%) and adequate in eight (66.6%) patients. No procedure-related deaths and symptomatic complications were reported.

In this case considering the nature of the blister aneurysm, a high chance of rebleed was estimated if a stent-assisted coiling or FD placement was performed, due to anticoagulation therapy prior to treatment and to manipulations and coiling attempts at the aneurysm site. Therefore, parent vessel occlusion was considered the treatment of choice. Attempt to achieve parent vessel occlusion by coiling failed because of the coil luxation due to high flow. A WEB device offered more accuracy and maintained more stable position after deployment compared to coils. To reduce the chance of rapid thrombus formation and thrombus migration, 300 mg Aspegic IV was given to the patient after deployment and the patient was on a daily dose of 80 mg Aspirin for the next 3 months.

Conclusion

BLAs are rare and are often a diagnostic and therapeutic challenge. BLAs located in the vertebrobasilary territory are very rare, and even more challenging to treat when located at a fenestration site. Surgery in BLAs has a higher morbidity and mortality rate than endovascular treatment in atypical locations.[4] FDs are the most promising endovascular treatment option.

In this case, other surgical or endovascular options were not possible and therefore we treated this bilobed BLA on a fenestration located in the right vertebrobasilary artery using a WEB device. The BLA was successfully embolized with the off-label use of this device. A WEB device might be considered as a treatment option for main vessel occlusion in atypical locations of BLAs when other treatment options are not possible.

Informed Consent

Before the treatment, the procedure was explained to the patient to try coiling firs and if that would not work, the use a WEB device was discussed. The patient gave written consent. In this case, the WEB device was the best medical treatment option for the patient. Our ethical board institution waived this treatment.

Disclosure Statement

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