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Endovascular treatment of acute basilar artery occlusion with a distal intracranial aneurysm: A case report and literature review

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Abstract

Acute basilar artery occlusion (BAO) is a devastating disease with high mortality and morbidity. Early recanalization is crucial to achieve a good prognosis. However, little literature is available on endovascular mechanical thrombectomy (MTE) for treatment of acute BAO with a distal intracranial aneurysm. We describe a patient of BAO with concomitant BA tip aneurysm, who was successfully treated by endovascular MTE, and recovered uneventfully during the three month follow-up period after discharge. We believe that ischemic stroke patients with a concomitant aneurysm are at increased risk of aneurysmal rupture and should be managed with tailored endovascular strategies, and that stent thrombectomy may be an effective approach for BAO patients who also harbor intracranial aneurysms. In this report, we also review the literature related to the treatment of BAO with a concomitant aneurysm.

Keywords: Ischemic stroke, basilar artery occlusion, mechanical thrombectomy, intracranial aneurysm

INTRODUCTION

Acute basilar artery occlusion (BAO) is a subgroup of posterior circulation ischemic stroke, accounting for approximately 6% -10% of intracranial large vascular occlusion.[1] Acute BAO has a poor prognosis with a mortality rate of 85%[2] and with a severe disability rate of more than 65%.[3] The prevalence of intracranial aneurysm in the general population is approximately 3.2%[4] and 9.3% in patients with ischemic stroke[5,6], because these patients usually have common risk factors such as hypertension, atherosclerosis, smoking and ageing.[7-9] Studies have shown that patients with large vessel occlusion strokes (LVOS) have a coincidental aneurysm prevalence rate of 3.7-5.6%.[10,11] In these studies, the target vessel-related prevalence was significantly higher in the anterior circulation than in the posterior circulation. It is uncommon that acute BAO is concomitant with a distal aneurysm. The key to efficient treatment of acute BAO is early revascularization, which can significantly improve the patient's prognosis and reduce mortality.[12-14] One of these treatments is endovascular mechanical thrombectomy (MTE).[15] However, little literature is available on MTE in acute ischemic stroke with coincident ipsilateral unruptured aneurysm, especially with an aneurysm distal to the BA occlusion site. In this report, we describe a patient with an acute occlusion of the middle segment of the basilar artery (BA) with coincident BA tip aneurysm. We successfully treated this patient with an endovascular stent retriever. We believe that ischemic stroke patients with a concomitant aneurysm are at increased risk of aneurysmal rupture and should be managed with tailored endovascular strategies, and that stent thrombectomy may be an effective approach for BAO patients who also harbor intracranial aneurysms. In this report, we also reviewed the literature related to the treatment of BAO with a concomitant aneurysm. This report was approved by the Review Board of the Institute and the patient provided written consent.

CASE REPORT

A 60-year old female patient was admitted to our hospital on August 31, 2019 due to " paroxysmal dizziness and poor speech fluency for 2 days". This patient had a history of hypertension for more than 20 years with unsatisfactory blood pressure control, and has also been smoking for over 40 years with an average of one pack per day. Two days ago, the patient underwent an emergency computed tomography (CT) at another hospital, which excluded cerebral hemorrhage. She was treated with antiplatelet, anti-hypertensive and

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statin drugs. Her symptoms worsened while standing and she was then transferred to our hospital. On admission, her score of National Institute of Health Stroke Scale (NIHSS) was 3. This patient underwent the emergency brain diffusion weighted imaging (DWI) at admission, which showed (Figure 1a, b) multiple cerebral infarctions in bilateral cerebellar hemispheres, bilateral pons, and left occipital lobe. Her DWI-pc-ASPECT score was 6 and pons-midbrain index was 2. Two hours after admission, the patient exhibited sudden deterioration in her symptoms, including sudden loss of consciousness and dyspnea. Physical examination revealed shortness of breath with disturbed rhythm, moderate coma, decerebrate rigidity, staring to the right, bilaterally equal pupils with a diameter of 2.5 mm and reactivity to light, no response to pain stimulation in the right limb. The patient had a NIHSS score of 30 and a Glasgow Coma Scale/Score (GCS) score of 6. Considering the possibility of progressive stroke-acute basilar trunk artery occlusion, we did not perform intravenous thrombolysis after emergency tracheal intubation. After the family members of this patient signed the consent, we proceeded with endovascular treatment.

Cerebral angiography showed: the right posterior communicating artery was not blocked, the top of the BA was visualized together with an aneurysm of a size of less than 5 mm (Figure 2a, b); the left vertebral artery was thin, and the intracranial segment farther from V4 was not visualized (Figure 2c); the distal part of the right lateral vertebral-BA junction was occluded (Figure 2d). Etiological classification of this patient was aortic atherosclerosis with no history of atrial fibrillation and no abnormal electrocardiogram, and she was diagnosed as acute occlusion following the original BA stenosis. Treatment strategy was BA angioplasty after MTE. Under general anesthesia, we chose the right vertebral artery approach, passed a 6F guide catheter to the distal end of the right vertebral artery V2, with a 0.014 synchro-14 microlead wire to guide the headway-21 microcatheter carefully through the occluded segment to the distal BA (the proximal site of aneurysm), followed by microcatheter angiography, which confirmed that the distal vessel was unobstructed and did not affect the aneurysm (Figure 3a). After we used the Trevo thrombectomy stent (4 × 20 mm) to remove the thrombus, the residual stenosis in the lower segment of BA was approximately 90% (Figure 3b). Thereafter, we dilated the gateway 2.25 × 15 mm balloon once (Figure 3c). After these procedures, the residual stenosis was reduced to approximately 30%, the forward blood flow was restored to the mTICI grade 3 level, and the basilar and posterior cerebral arteries were well visualized (Figure 3d, e). After the operation, tirofiban was given intravenously for 24 hours, and aspirin and Plavix were given orally 4 hours before the drug was stopped. It took 35 minutes from puncture to the first reperfusion. The patient had a NIHSS score of 10 immediately after surgery, and 5 at 2 weeks after discharge. The brain DWI and magnetic resonance angiogram (MRA) revealed the left pontine infarction and unobstructed main vertebral BA (Figure 4a, b). After discharge from the hospital and follow-up by clinic visit and telephone, the patient was able to take care of herself in the activities of daily living. Three months after discharge, the patient had a Modified Rankin Scale (mRS) score of 1.

DISCUSSION

Although the recent trial of Basilar Artery Occlusion Endovascular Intervention versus Standard Medical Treatment (BEST), which was

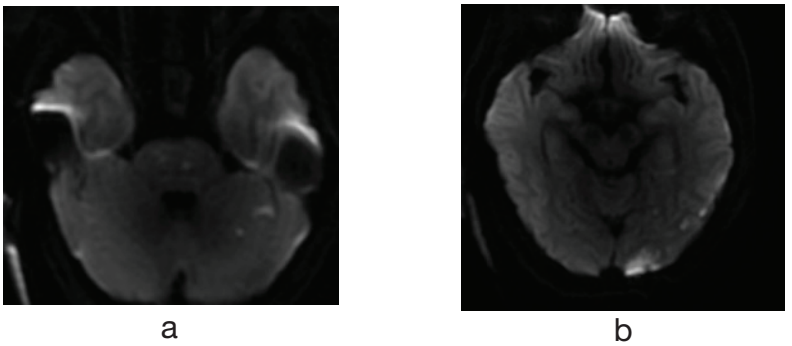


Figure 1. Brain DWI examination at admission. Infarction of bilateral cerebellar hemisphere (a) and pons plus left occipital lobe (b).

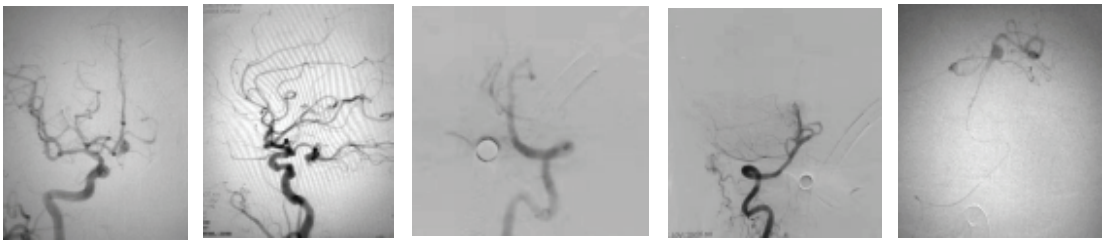


Figure 2. Angiography. The right common carotid artery, upright position (a) and lateral position (b). The left subclavian artery (c) and the left vertebral artery is slender, and the intracranial segment further from V4 is not visualized; right vertebral artery (d) occlusion distant from the right vertebra-basal artery junction. (e) Microcatheter imaging at the distal end of the basilar artery (proximal to the aneurysm: the distal vessel is unobstructed and does not affect the aneurysm.

designed to examine the efficacy and safety of endovascular treatment of acute strokes caused by vertebrobasilar artery occlusion, showed no significant difference in the appreciable outcomes between endovascular and standard treatments, patients with BAO who were treated with endovascular MTE achieved better outcomes than patients treated with standard medical therapy.[16] In this case, the patient had an acute BAO with concomitant distal intracranial aneurysm, and we performed endovascular MTE immediately after the symptoms worsened. In order to save time for treatment, we did not carry out intravenous thrombolysis. Our treatment achieved a favorable outcomes for this patient, at least during the three-month follow-up period after discharge.

Currently, little literature is available on MTE in acute ischemic stroke with coincident ipsilateral unruptured aneurysm, especially with an aneurysm distal to the BA occluded site. We reviewed the literature and identified 4 individual case reports where the patient presented with acute stroke due to BAO but also had an aneurysm in the affected blood vessel (Table 1).[10,11,17,18] Including this report, the total number of cases of BAO with an aneurysm is 5. All these 5 cases had the location of aneurysms at the tip of BA, and were mainly small aneurysms, with an average size of 3-5 mm. Considering the risk of invasive treatment in an asymptomatic aneurysm, the first choice of treatment is often observation and follow-up. These 5 cases eventually had successful recanalization of blood vessels with no aneurysm rupture during the operations, and the forward blood flow reached a grade of 2b-3. Among these 5 cases, Case 1 had spontaneous recanalization after BAO.[17] In Case 2, arterial thrombolysis was given after consideration of the risk of endovascular treatment.[18] Cases 3[10] and 4[11] were similar to our case in that both cases had the MTE of the retrievable stent. However, Case 4 had bridge thrombus removal after intravenous thrombolysis within the time window, while Case 3 only had mechanical thrombus removal. Although Case 4

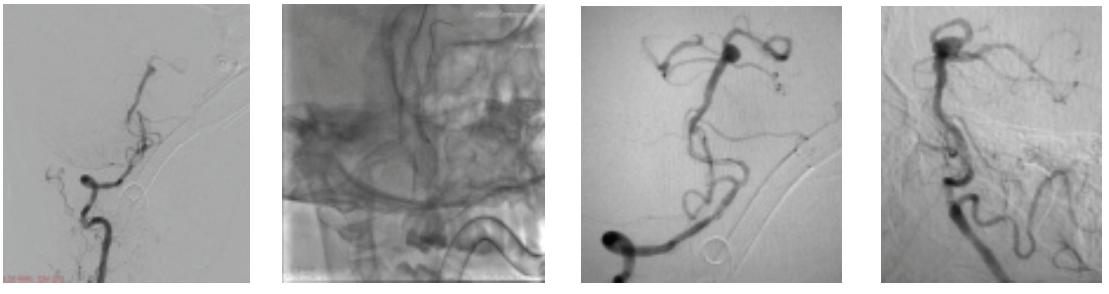
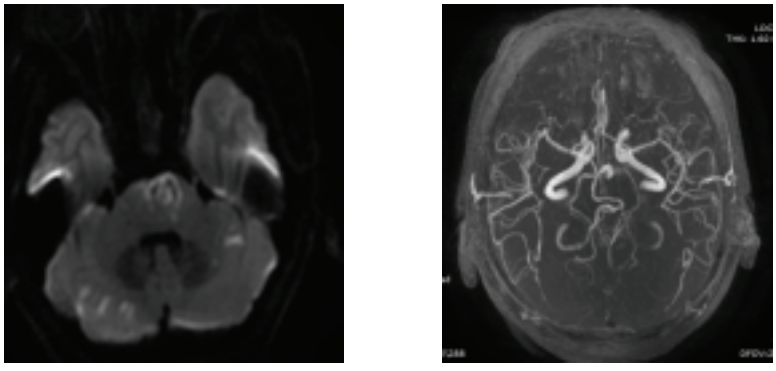


Figure 3. Angiography during and after operation. (a) After first thrombectomy: the residual stenosis of the lower segment of the BA is approximately 90%. (b) The balloon (2.25 × 15 mm) is dilated to reduce the stenoses. (c) The residual stenosis after balloon dilation is approximately 30%, the forward blood flow is restored to the mTICI grade 3, and the basilar and posterior cerebral arteries are well developed. (d) postoperative vertebral angiography (lateral position).



a b

Figure 4. Postoperative brain DWI and MRA. (a) The brain DWI shows left pontine infarction. (b) Brain MRA shows the patency of the vertebrobasilar trunk artery.

successfully achieved recanalization after surgery, he eventually died. In our patient, because of an acute stroke, we chose a direct mechanical stent to remove the thrombus. At the same time, we performed balloon dilation in the middle of the BA to overcome the severe thrombosis, and finally achieved a TICI grade 3. Our patient had a good prognosis with a mRS grade of 1 during follow up.

Nevertheless, we still believe that endovascular treatment of BAO combined with a distal aneurysm by stent removal may increase the risk of aneurysm rupture. First, before stent release, the microwire and microcatheter must pass through the thrombosed blood vessel to the distal vessel lumen, which may increase the risk of perforation of the distal aneurysm. Hence, we recommend passing the guidewire with its tip shaped like an inverted ''U'' to avoid penetration of the aneurysm even if the guidewire has to enter the aneurysm sac. Sometimes the guidewire tip seems to go in the midline beyond the normal perceived anatomy of the BA or its branches, and in this case, we believed that we did not perforate the aneurysm as the tip of the guidewire was shaped to be blunt. Second, stent release will increase the shear force on the vessel wall, which may lead to the rupture of the fragile aneurysm. In this regard, aspiration techniques including 'A direct aspiration first pass technique' (ADAPT)[19] may exert lower shear forces on the vessel wall than stent retrievers. Moreover, they do not always need to pass through the thrombus and navigate into invisible vessel segments. Li *et al*.[20] reported a case of an aneurysm on the posterior communicating segment of the left internal carotid artery with an occlusion of the middle cerebral artery, which was treated with the ADAPT technology (Sofia, 6F plus) and LVIS stent-assisted embolization, and believed that ADAPT was safer for such cases. However, ADAPT technology may require a remedy of stent-assisted removal of thrombus for ICAD lesion-caused acute occlusion.[19] Third, the sudden increase in hemodynamics after successful thrombectomy may cause aneurysm rupture. This include aneurysms at bifurcation sites, such as the middle cerebral artery bifurcation and the BA apex. Therefore, simultaneous endovascular treatment of aneurysms requires individualized analysis.

Indeed, different approaches have been used for the treatment of BAO with an aneurysm,

Table 1: Literature related to acute stroke due to BA occlusion with a concomitant BA aneurysm in the affected blood vessel

References	Occluded Vessel	Location	Size (mm)	Therapy	Rupture or not	TICI score	mRS (90 day)
Case 1 1998[17]	BA	BA tip		Fibrinolysis	No	2b	-
Case 2 2015[18]	BA	BA tip	<5	IA rtPA	No	2b	-
Case 3 2015[19]	PCA(P1)	BA tip	3	stent retriever	No	3	-
Case 4 2018[11]	BA	BA	3.5×3	IV-rtPA+Solitaire	No	2b	6
Our report 2020	BA	BA tip	<5	stent retriever+angioplasty	No	3	1

including intravenous thrombolysis and MTE.[21] However, the vast majority of studies that may lead to rewrite the treatment guidelines focus on the large vessel occlusion of the anterior circulation and did not include patients with stroke of the posterior circulation. Although the latest BEST study did not show better efficacy in the recanalization rate of endovascular MTE compared with the standard therapy, it provides an important reference for this treatment.[16]

Early vascular recanalization is the key to save the ischemic penumbra, the tissue that surrounds the core infarcted region that is the major therapeutic target for ischemic treatment[21] and thus effectively improve the prognosis of patients, and reduce mortality.[4-6] Most previous studies have reported that endovascular treatment of anterior circulation combined with aneurysms include stent removal and catheter aspiration[10,14,17,18,22,23]; few reports were on those with distal aneurysms. A retrospective study from a German single center[10] reported 300 patients who received AIS-LVO MTE. Among these patients, 11 had aneurysms (3.7%), with 10 in the anterior circulation and 1 in the posterior circulation. ADAPT was the first choice, followed by stent remediation if needed. However, the vascular recanalization was low (45%). In one case, the middle cerebral artery bifurcation aneurysm ruptured and bleeding occurred after the stent removal of thrombus. Only one case of the posterior circulation stroke was a BA apex aneurysm, and revascularization was successfully achieved after two stent removal of thrombus.

In conclusion, we believe that endovascular treatment of BAO with aneurysms is still risky. Specific treatment option should be carefully determined and the first choice should be aspiration after the full evaluation of the risk of treatment. If it fails, then stent removal of thrombus should follow. At the same time, the surgeon should be more versatile, and able to handle both ischemic and hemorrhagic situations. We also learned from this case that the occluded blood vessels should be fully preoperatively assessed prior to thrombectomy, in particular, we should take full advantage of digital subtraction angiography (DSA) during the operation.

DISCLOSURE

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Conflict of interest: None

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