Online March 31, 2020
Journal of Neuroendovascular Therapy 2020; 14: 215–221 DOI: 10.5797/jnet.cr.2019-0024

Case Report

Treatment Strategies for Basilar Top Syndrome Caused by Acute Vertebral Artery Occlusion

Iori Kojima, Rin Shimozato, Mototaka Hayashi, and Akira Iijima

Objective: We report a patient with basilar artery embolism caused by vertebral artery stenosis who was successfully treated using simultaneous percutaneous transluminal angioplasty (PTA) and mechanical thrombectomy.
Case Presentation: A 64-year-old male, who had undergone medical treatment for cerebellum infarction at another hospital, was referred to our hospital due to disturbance of consciousness. Angiography revealed acute occlusion of the first part of the right vertebral artery and an embolism of the top of basilar artery. After performing PTA to create an approach route for the embolism, we collected it using a clot recovering device. The postoperative course was good, and the patient was discharged with mild ataxia and dysarthria.
Conclusion: We report the successful treatment of progressive cerebral infarction of the posterior circulation with revascularization 30 hours after symptom onset. Unlike the anterior circulation, the posterior circulation consists of smaller arteries and fewer collateral arteries, making it vulnerable to ischemic attack. Therefore, shortening the time until treatment may improve the outcome.

Keywords ▶ cerebral infarction, basilar artery occlusion, vertebral artery stenosis

Introduction

In acute-phase cerebral infarction treatment using catheters, the development of new device has increased the number of patients to be treated and improved the results of treatment. However, this treatment is indicated only in comparative studies involving patients with anterior circulation occlusion, and no guidelines for the indication of catheter treatment for posterior circulation occlusion have been established.

Case Presentation

Case: A 64-year-old male with a history of diabetes mellitus, hyperlipidemia, and hyperuricemia. To treat these diseases, drugs had been orally administered. Cerebellar infarction with dizziness developed, and he was transported to a hospital by ambulance. Under a diagnosis of atherothrombotic cerebellar infarction, medical treatment was performed (**Fig. 1a** and **1b**). Consciousness disturbance was noted in the afternoon the day after admission, and he was referred to our hospital to examine whether catheter treatment was appropriate. Due to the progression of symptoms, the infarcted cerebellar focus had enlarged in comparison with magnetic resonance imaging (MRI) findings obtained from the previous hospital. Magnetic resonance angiography (MRA) demonstrated interruption of the vertebral basilar artery (**Fig. 1c** and **1d**). The National Institute of Health Stroke Scale (NIHSS) score was 9.

The disease type was evaluated as atherothrombotic cerebral infarction. Regarding the pathogenesis, a diagnosis of arteriogenic embolism related to atherostenosis at the origin of the right vertebral artery was made. Prior to mechanical thrombectomy, angiography was started 30 hours after initial symptom onset. As a result, occlusion at the origin of the right vertebral artery (left vertebral artery: PICA ending on MRA) was observed. The right vertebral artery was slowly enhanced via a collateral pathway from the muscular branch of the deep cervical artery (**Fig. 2a** and **2b**); an embolus floating at the terminal of the basilar

Department of Neuroendovascular Treatment, JCHO Tokyo Shinjuku Medical Center, Tokyo, Japan

Received: April 14, 2019; Accepted: March 3, 2020
Corresponding author: Rin Shimozato. Department of Neuroendovascular Treatment, JCHO Tokyo Shinjuku Medical Center, 5-1 Tukudo-cho, Shinjuku, Tokyo 162-8543, Japan
Email: imnrstz@gmail.com

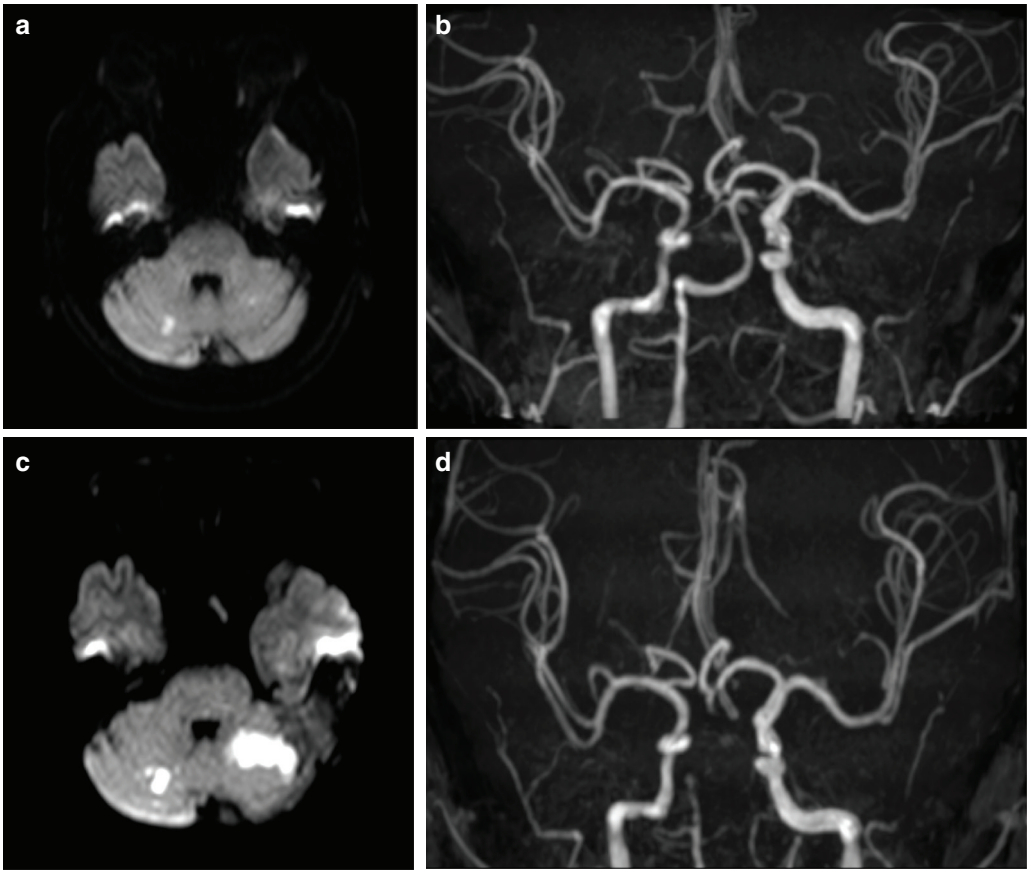

Fig. 1 MRI and MRA, taken on admission at previous hospital, show minor infarction on the right side of the cerebellar hemisphere and intact BA (**a** and **b**). MRI and MRA, taken on admission to our hospital, show additional infarction on the other side of the cerebellar hemisphere and BA occlusion (**c** and **d**). BA: basilar artery; MRA: magnetic resonance angiography; MRI: magnetic resonance imaging

artery was confirmed. Based on these findings, a diagnosis of acute right vertebral artery occlusion and arteriogenic basilar artery embolism was made. To retrieve the embolus and achieve basilar artery recanalization, we selected mechanical thrombectomy following percutaneous transluminal angioplasty (PTA) at the origin of the right vertebral artery.

After exchanging a sheath introducer to a 9Fr sheath introducer (Super Sheath: Togo Medikit, Miyazaki), an 8Fr guiding catheter (Fubuki: Asahi Intecc, Aichi, Japan) was inserted into the right subclavian artery. We attempted to pass a coaxial system consisting of a 4Fr inner catheter (Todai type 2: Togo Medikit, Miyazaki) and 0.035/150-cm guidewire (Excel Med: Aubex, Tokyo, Japan) through the site of vertebral artery stenosis, but could not pass the stenosis.

The system was removed, and the lesion crossing at the origin of the vertebral artery occlusion was achieved with a 0.014/200-cm microguidewire (CHIKAI: Asahi Intecc, Aichi, Japan) while placing the curve of a 4Fr inner catheter at the origin of the vertebral artery. An extension wire (Asahi Extension NV: Asahi Intecc, Aichi, Japan) was connected, and the 4Fr inner catheter was removed and exchanged to a GATEWAY 3.0/15 mm (Stryker, Kalamazoo, MI, USA). PTA was performed before and after the lesion, leading to recanalization (**Fig. 2c** and **2d**). To prevent the distal migration of intra-lumen thrombus, blood was manually aspirated through an 8Fr guiding catheter at the time of balloon deflation. After reconfirming the embolus at the terminal of the basilar artery (**Fig. 3a** and **3b**), a PX SLIM 160/5MAX ACE (Penumbra, Alameda, CL, USA) was guided to an area adjacent to the thrombus along the microguidewire (**Fig. 4a** and **4b**). After removing the PX SLIM, thrombolysis in cerebral infarction (TICI) 2b recanalization was achieved using the ADAPT technique (**Fig. 5a, 5b,** and **5c**). The treatment procedures suggested acute atherothrombotic occlusion at the site of vertebral artery stenosis and distal arteriogenic embolism. The post-treatment NIHSS score was 2. There were no treatment-related hemorrhagic or ischemic complications. After acute-phase cerebral infarction treatment in the intensive care unit, the

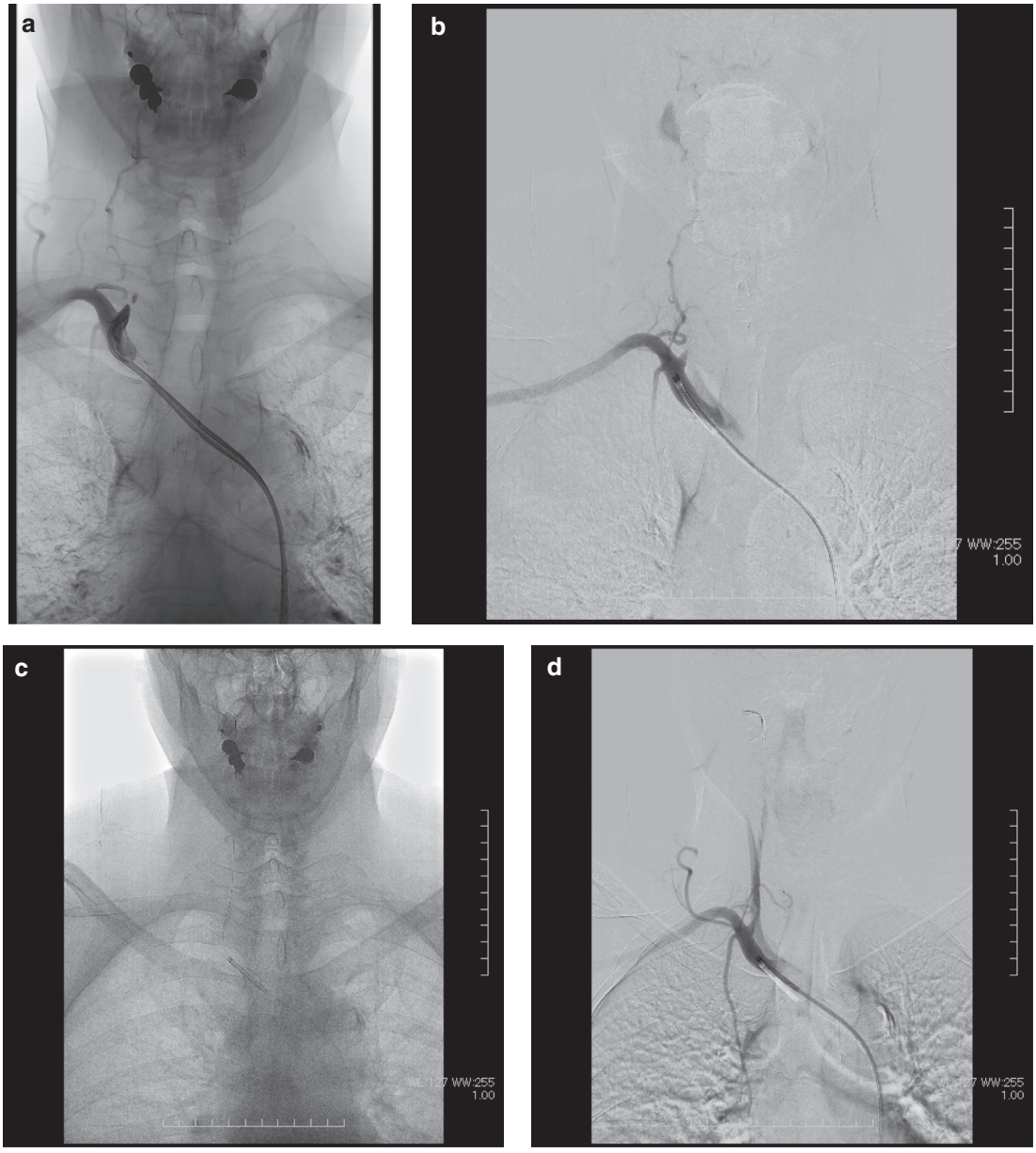

Fig. 2 Endovascular treatment procedure. Right subclavian anteroposterior angiography shows significant stenosis at the orifice of the VA with impaired anterograde flow and distal VA filling from the cervical collateral artery (**a** and **b**). Anteroposterior image obtained during balloon angioplasty of the right VA (**c**). Anteroposterior image obtained after balloon angioplasty of the right VA (**d**). VA: vertebral artery

patient was discharged through 3-week rehabilitation, with a modified Rankin Scale (mRS) score of 1.

On discharge, the administration of oral dual antiplatelets was started and follow-up was continued. However, after 1 year, restenosis at the origin of the vertebral artery was detected at the outpatient clinic (**Fig. 6a**). Endovascular treatment was selected. As stenosis was marked, stenting was performed after pre-PTA and the procedure was completed (**Fig. 6b**).

Discussion

As endovascular treatment for acute-phase embolism, mechanical thrombectomy has replaced thrombolysis therapy, improving the results of treatment.[1] On the other hand, the anterior circulation tandem occlusion-related mortality rate is 24%–27%, and it is reportedly 10%–29% in patients with a favorable prognosis (mRS score: 0–2).[2] There are two options for the endovascular treatment procedure: an

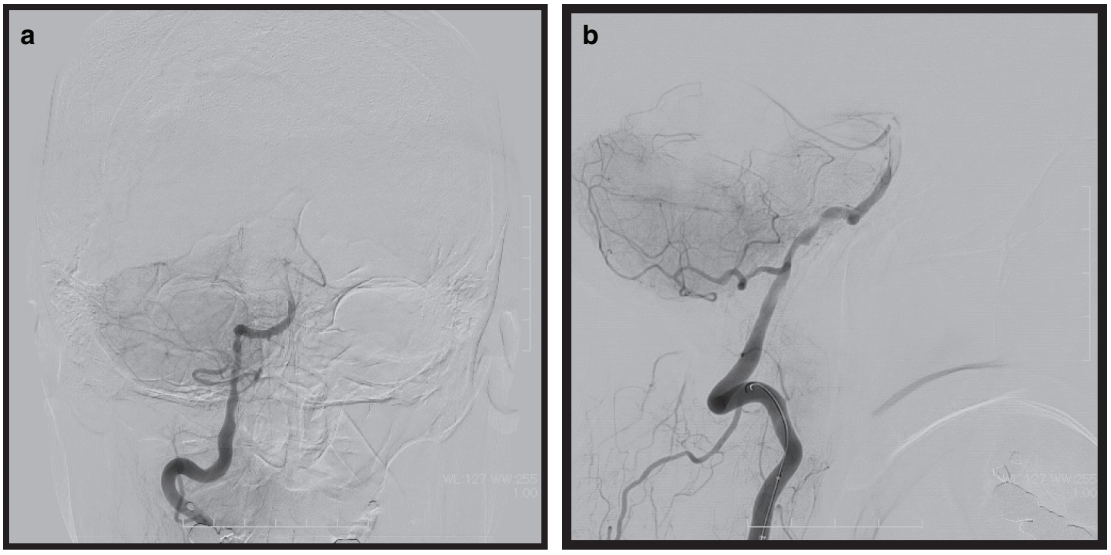

Fig. 3 Anteroposterior image of the BA shows embolism at the BA top (**a**). Lateral image of the embolism placed at the BA top (**b**). BA: basilar artery

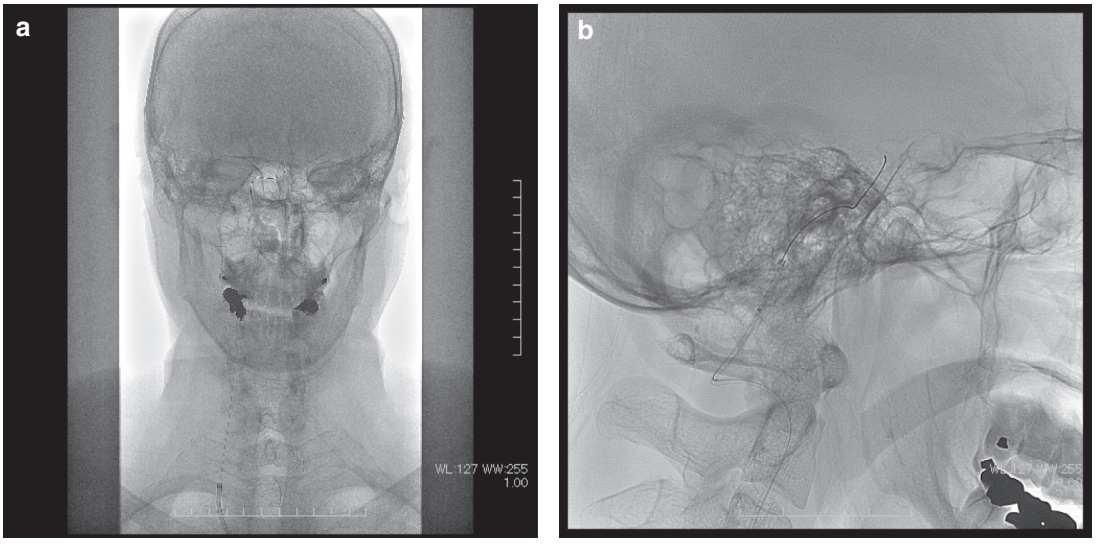

Fig. 4 Procedure of endovascular treatment. Anteroposterior/lateral images of the clot recovering device ascending to the BA top (**a** and **b**). BA: basilar artery

anterograde approach in which proximal revascularization is followed by distal revascularization, and a retrograde approach in which distal recanalization is prioritized. To treat proximal lesions, stenting or angioplasty is performed. To treat distal lesions, mechanical thrombectomy using a stent retriever or aspiration catheter, or thrombolysis is conducted. It is controversial which of the two approaches should be selected. The advantages of the anterograde approach are as follows: (1) angioplasty or stenting for a proximal lesion facilitates atherosclerotic plaque treatment and (2) an approach route is secured through recanalization of a proximal lesion, facilitating the treatment of a distal lesion.[3] On the other hand, when adopting the retrograde approach, the interval until recanalization is shorter, and the prognosis is better.[4] Furthermore, a previous study found no significant difference in the neurological prognosis between the antero- and retrograde approaches.[5]

Concerning the treatment of symptomatic posterior circulation vertebral artery stenosis, a previous study reported that there was no difference in the prognosis between endovascular and medical treatments.[6] On the other hand, the prognosis of patients with basilar artery embolism markedly differs among treatment methods. The Basilar Artery International Cooperation Study (BASICS) in 2009

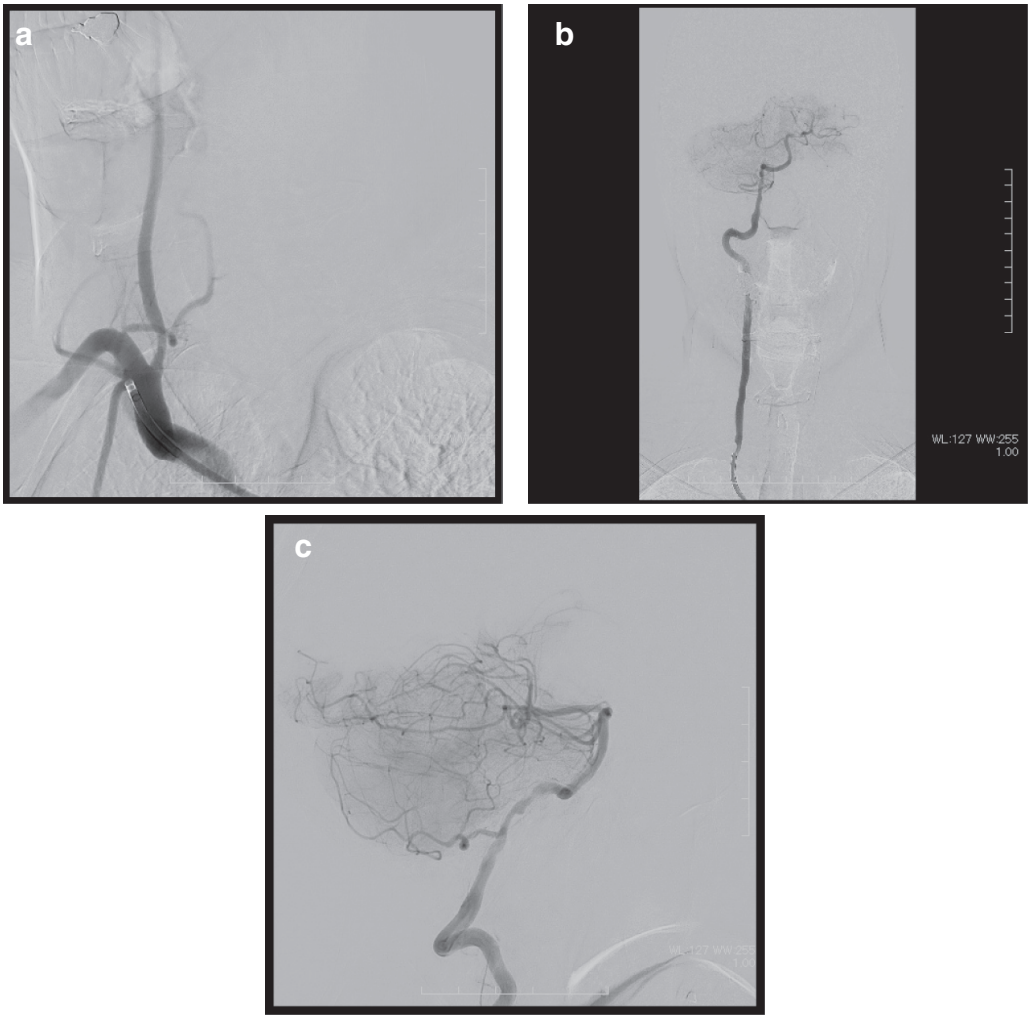

Fig. 5 Images after aspiration thrombectomy show that the VA and BA are completely recanalized (**a–c**). BA: basilar artery; VA: vertebral artery

reported that the mortality rates in groups treated by antithrombotic drug therapy, intravenous thrombolytic therapy, or transarterial thrombolytic therapy alone were 54%, 46%, and 49%, respectively. The results of mechanical thrombectomy by endovascular treatment varied among studies, but patients with a favorable prognosis (mRS score: 0–2) accounted for 29%–83%, and the mortality rate was significantly lower (0%–36%), suggesting the necessity of positive intervention by endovascular treatment.[7)]

The PC-CS (posterior circulation collateral score), which was proposed by Hoeven et al., facilitates the prediction of the prognosis of patients with basilar artery embolism through the assessment of posterior circulation system blood flow using computed tomography angiography (CTA).[8)] In the present case, CTA was not performed, and the PC-CS score was evaluated as 5 based on MRA findings. Due to the development of only a moderate collateral pathway, this patient was included in the unfavorable prognosis group.

Few studies have reported treatment for posterior circulation tandem occlusion, as demonstrated in the present case, in comparison with treatment for anterior circulation tandem occlusion. No guidelines have been established.[9)] Acute basilar artery occlusion complicated by unilateral vertebral artery occlusion or stenosis is not rare, and atherosclerotic stenosis is etiologically involved in basilar artery occlusion in many cases. In basilar artery occlusion patients with vertebral artery lesions, arteriogenic embolism must be considered.[10)] The prognosis of such patients with bilateral vertebral artery lesions is poorer. In the future, new therapeutic strategies should be examined.[11)]

As basic treatment strategies for posterior circulation tandem lesions, there are two options: an anterograde

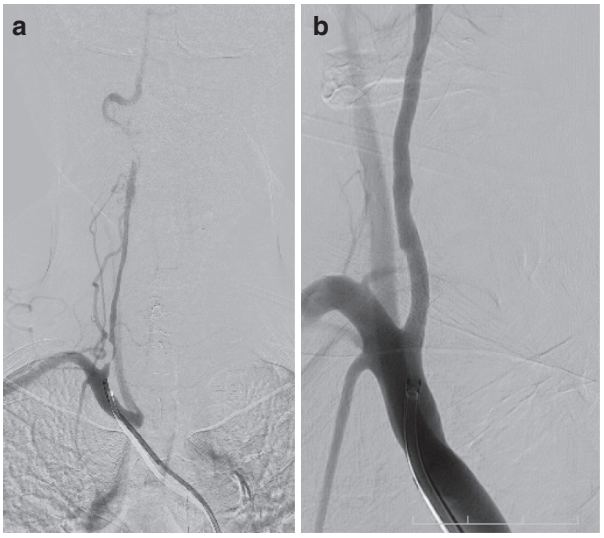

Fig. 6 Right subclavian anteroposterior angiography shows narrowing of the VA with impaired anterograde flow and distal VA filling from the cervical collateral artery (**a**). The image after the procedure. The VA is completely recanalized (**b**). VA: vertebral artery

approach in which basilar artery thrombectomy is performed after angioplasty for vertebral artery occlusion, as reported for the anterior circulation system, and a retrograde approach in which the latter is followed by the former.[12] As different frameworks, there are two options: a dirty road approach in which a lesion is reached through the stenotic vertebral artery, and a clean road approach in which a lesion is reached through the contralateral vertebral artery when it is patent.[13] Thus, four procedures, including the above antero-/retrograde approaches, are available.

In the present case, the unaffected-side vertebral artery involved the posterior inferior cerebellar artery (PICA) end, requiring a dirty road approach through the stenotic vertebral artery. If the unaffected-side vertebral artery is patent, a lesion can be reached in the shortest time safely; therefore, a clean road approach may be appropriate. However, if hypoplasia of the unaffected-side vertebral artery is observed, as demonstrated in the present case, or if aplasia or occlusion is present, a dirty road approach must be selected. Furthermore, internal carotid artery-mediated treatment through the Pcom or P1 may be considered, but the procedure is complex.

When adopting a dirty road approach, the vertebral artery diameter is essentially smaller than the internal carotid artery diameter; therefore, it is impossible to ascend a system to the basilar artery in most patients with stenotic lesions. Initially, it is necessary to secure an approach route to the site of peripheral embolism by PTA or stenting.[13,14] Subsequently, a basilar artery embolus should be collected (dirty road-anterograde approach).

It is controversial which of the two procedures, PTA and stenting, should be selected for stenotic vertebral artery lesions. However, we selected vertebral artery recanalization therapy by PTA alone for the following reasons: (1) stenting may prolong the interval until recanalization, (2) the stent position may deviate on retrieving a thrombus, and (3) the system may get caught. As a prognostic factor for vertebral/basilar artery occlusion, the interval until recanalization is more important than the percent recanalization according to several studies.[13,14] Early thrombectomy should be prioritized. Whether stenting for vertebral artery stenosis should be performed after posterior circulation recanalization is achieved depends on the surgeons' evaluation. In the present case, MRI revealed marked enlargement of the infarcted focus, suggesting the induction of hemorrhagic infarction by antithrombotic therapy; therefore, PTA alone was performed. However, several studies reported that there was no hemorrhagic lesion even when the procedure was completed after stenting at the stenotic site of the vertebral artery.[9,13] To prevent posterior circulation system restenosis related to arteriogenic embolism, the positive indication of stenting should be considered. Furthermore, two-stage treatment is another option: stenting is performed when stenosis exacerbates during the postoperative course, as demonstrated in the present case.

In our patient, endovascular treatment led to a favorable outcome despite poor prognostic factors such as a long interval from symptom appearance, bilateral vertebral artery occlusion, and progressive symptoms. This was because basilar artery recanalization was achieved in a short time. In the posterior circulation system, the number of collateral pathways is smaller than in the anterior circulation system, and the former may be more markedly influenced by ischemia. In patients with posterior circulation occlusion, early-recanalization-prioritized treatment (dirty road-anterograde approach with PTA) may be rational. Currently, the number of case reports on endovascular treatment for posterior circulation tandem lesions is limited, and a favorable prognosis was achieved in only a few patients.[9,13,14] The present case may aid in the preparation of future treatment guidelines.

Conclusion

We reported a patient in whom one-stage endovascular treatment for basilar artery embolism, of which the source was vertebral artery stenosis, was performed.

Few studies have reported endovascular treatment for tandem occlusion in the posterior circulation system. We

performed PTA and mechanical thrombectomy, leading to a favorable outcome.

In the posterior circulation system, the arterial diameter is smaller than that in the anterior circulation system, and collateral pathways are underdeveloped; therefore, the former may be more markedly influenced by ischemia.

A dirty road-anterograde approach with PTA, in which the shortening of intervals until thrombectomy and blood flow recanalization is prioritized, may be useful for patients with posterior circulation tandem occlusion.

Disclosure Statement

We declare no conflict of interest regarding this article.

References

1) Kappelhof M, Marquering HA, Berkhemer OA, et al: Intra-arterial treatment of patients with acute ischemic stroke and internal carotid artery occlusion: a literature review. *J Neurointerv Surg* 2015; 7: 8–15.
2) Kimura K, Iguchi Y, Shibasaki K, et al: Recanalization of the MCA should play an important role in dramatic recovery after t-PA therapy in patients with ICA occlusion. *J Neurol Sci* 2009; 285: 130–133.
3) Rangel-Castilla L, Rajah GB, Shakir HJ, et al: Management of acute ischemic stroke due to tandem occlusion: should endovascular recanalization of the extracranial or intracranial occlusive lesion be done first? *Neurosurg Focus* 2017; 42: E16.
4) Mbabuike N, Gassie K, Brown B, et al: Revascularization of tandem occlusions in acute ischemic stroke: review of the literature and illustrative case. *Neurosurg Focus* 2017; 42: E15.
5) Wilson MP, Murad MH, Krings T, et al: Management of tandem occlusions in acute ischemic stroke - intracranial versus extracranial first and extracranial stenting versus angioplasty alone: a systematic review and meta-analysis. *J Neurointerv Surg* 2018; 10: 721–728.
6) Lattanzi S, Brigo F, Di Napoli M, et al: Endovascular treatment of symptomatic vertebral artery stenosis: a systematic review and meta-analysis. *J Neurol Sci* 2018; 391: 48–53.
7) Morales A, Parry PV, Jadhav A, et al: A novel route of revascularization in basilar artery occlusion and review of the literature. *J Neurointerv Surg* 2016; 8: e25.
8) van der Hoeven EJ, McVerry F, Vos JA, et al: Collateral flow predicts outcome after basilar artery occlusion: the posterior circulation collateral score. *Int J Stroke* 2016; 11: 768–775.
9) Baik SH, Park HJ, Kim JH, et al: Mechanical thrombectomy in subtypes of basilar artery occlusion: relationship to recanalization rate and clinical outcome. *Radiology* 2019; 291: 730–737.
10) Oláh C, Kardos Z, Sepsi M, et al: Assessment of intracranial vessels in association with carotid atherosclerosis and brain vascular lesions in rheumatoid arthritis. *Arthritis Res Ther* 2017; 19: 213.
11) Compter A, van der Hoeven EJ, van der Worp HB, et al: Vertebral artery stenosis in the Basilar Artery International Cooperation Study (BASICS): prevalence and outcome. *J Neurol* 2015; 262: 410–417.
12) Yang H, Ma N, Zhang S, et al: Endovascular revascularisation of acute tandem vertebrobasilar artery occlusion: seven case series with literature reviews. *Stroke Vasc Neurol* 2018; 3: 17–21.
13) Siebert E, Bohner G, Zweynert S, et al: Revascularization techniques for acute basilar artery occlusion: technical considerations and outcome in the setting of severe posterior circulation steno-occlusive disease. *Clin Neuroradiol* 2019; 29: 435–443.
14) Cohen JE, Leker RR, Gomori JM, et al: Emergent revascularization of acute tandem vertebrobasilar occlusions: endovascular approaches and technical considerations-confirming the role of vertebral artery ostium stenosis as a cause of vertebrobasilar stroke. *J Clin Neurosci* 2016; 34: 70–76.