

Thrombectomy using Trevo ProVue Stent Retriever Devices after Recombinant Tissue Plasminogen Activator Thrombolysis for Acute Basilar Artery Occlusion during Vertebral Artery Dissection

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Abstract

A 41-year-old woman was admitted due to a sudden-onset severe headache, left hemiparesis and dysarthria. Diffusion-weighted magnetic resonance imaging showed an acute infarct in the bilateral pons, and magnetic resonance angiography revealed basilar artery (BA) occlusion resulting from dissection of the right vertebral artery (VA). She was treated with intravenous recombinant tissue plasminogen activator (rt-PA) 110 minutes after symptom onset. Subsequently, brain angiography was performed along with mechanical thrombolysis using Trevo ProVue retriever devices. The BA was successfully recanalized 240 minutes after the onset of symptoms. Thrombectomy is a promising treatment strategy for cases of VA dissection resistant to intravenous rt-PA thrombolysis.

Key words: Trevo ProVue stent retriever, thrombectomy, rt-PA, basilar artery occlusion, vertebral artery dissection

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Introduction

Acute occlusion of the basilar artery (BA) accounts for approximately 10% of strokes and presents a therapeutic challenge for both neurologists and interventional neuroradiologists. The clinical course under medical treatment, including intravenous heparin therapy, is extremely severe, with a mortality rate ranging from 40% to 86% (1). The major predictive factor for a good outcome is the speed of occluded vessel recanalization (2, 3). According to recent publications, mechanical thrombectomy seems to be a safe and efficient technique for achieving recanalization in cases of acute arterial occlusion (4-6).

We herein present a case involving the successful mechanical removal of a site of obstruction in a patient with

acute BA occlusion using Trevo retriever devices after right vertebral artery (VA) dissection, with both good angiographic and clinical outcomes.

Case Report

A 41-year-old Japanese woman presenting with a sudden-onset severe headache, left hemiparesis and dysarthria was referred to our hospital. She had no history of traumatic injury or medical history of diabetes, glucose intolerance, arterial hypertension, hypercholesterolemia, smoking, obesity or other risk factors. In addition, there was no personal or family history of neurological disorders. Her condition worsened within a few minutes, associated with the appearance of left hemiparesis and a rapid degradation of consciousness, with a National Institutes of Health Stroke Scale (NIHSS)

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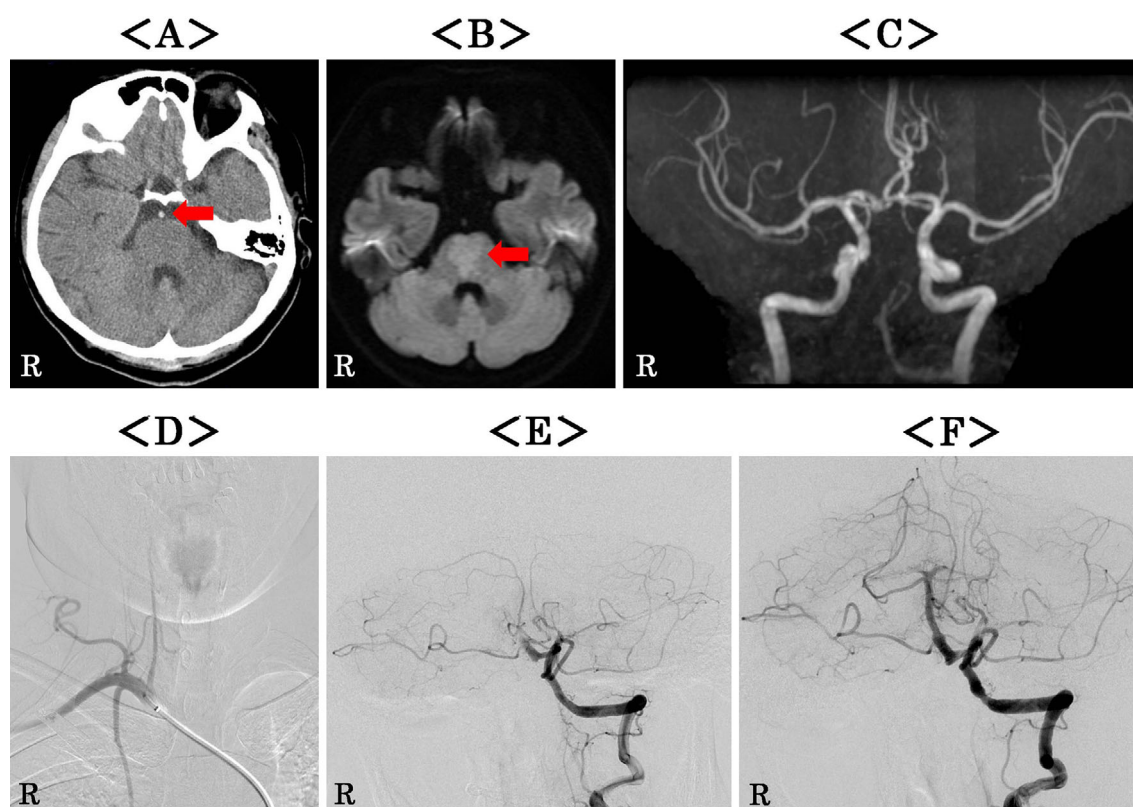


Figure 1. Neuroradiology images on admission. (A) Unenhanced computed tomography (CT) revealed spontaneous hyperdensity in the lumen of the basilar artery (BA) as a hyperintense BA sign (arrow). (B) Diffusion-weighted images (DWI) of brain magnetic resonance imaging (MRI) showed acute infarcts in the middle and both sides of pons (arrow). (C) Unenhanced magnetic resonance angiography (MRA) demonstrated occlusion of the BA involving the right vertebral artery (VA). (D) Brain digital subtraction angiography (DSA) via the left VA revealed occlusion of the middle portion of the BA. (E) The blood flow of the right VA was stopped via the right subclavian artery approach before the transverse foramen in DSA. (F) The BA was successfully recanalized after thrombectomy to a cerebral infarction (TICI) grade of 3. R: right

score of 16. Unenhanced computed tomography scans obtained on admission revealed spontaneous hyperdensity in the lumen of the BA as a hyperintense BA sign (Fig. 1A). Diffusion-weighted images (DWI) of intracranial magnetic resonance imaging (MRI) showed acute infarcts in the middle and both sides of the pons (Fig. 1B), and unenhanced magnetic resonance angiography (MRA) demonstrated occlusion of the BA involving the right VA (Fig. 1C). Recombinant tissue plasminogen activator (rt-PA) (0.6 mg/kg of alteplase, with 10% given as a bolus followed by continuous infusion of the remainder over 1 hour, which is lower than the internationally approved dose of 0.9 mg/kg) (7) was administered intravenously to the patient three hours after the onset of symptoms. However, no clinical improvement was noted after one hour; therefore, endovascular treatment was applied.

Urgent thrombectomy with brain digital subtraction angiography (DSA) was organized three hours after the time of arrival to the hospital. The blood flow of the right VA was stopped via the right subclavian artery approach before the transverse foramen (Fig. 1D). DSA via the left VA revealed

occlusion of the middle portion of the BA (Fig. 1E). A Trevo 4×20 mm stent retriever (Concentric Medical, Mountain View, CA) (8) was deployed from the left P1 segment to the mid-basilar trunk and slowly withdrawn during simultaneous guided catheter aspiration. The procedure was then repeated with the stent deployed in the left P1. In total, two passes were made until a normal flow into the basilar artery trunk was achieved. The BA was successfully recanalized to cerebral infarction (TICI) grade 3 after 240 minutes from symptom onset following thrombectomy (Fig. 1F), and the patient's NIHSS score immediately decreased to 3.

Follow-up intracranial unenhanced MRI and MRA were performed on day 8. DWI revealed multiple punctiform infarcts in the right medulla oblongata and pons. A small area of hemorrhage was also found in the right front region of the pons (Fig. 2A, B); all regions were asymptomatic. MRA revealed complete recanalization in the BA from the left VA, with insufficient recanalization in the right VA (Fig. 2C). In the brainstem region, MRI showed an intramural dissecting hematoma, appearing as a rounded high signal on T1-weighted imaging (Fig. 2D) and a double-lumen structure

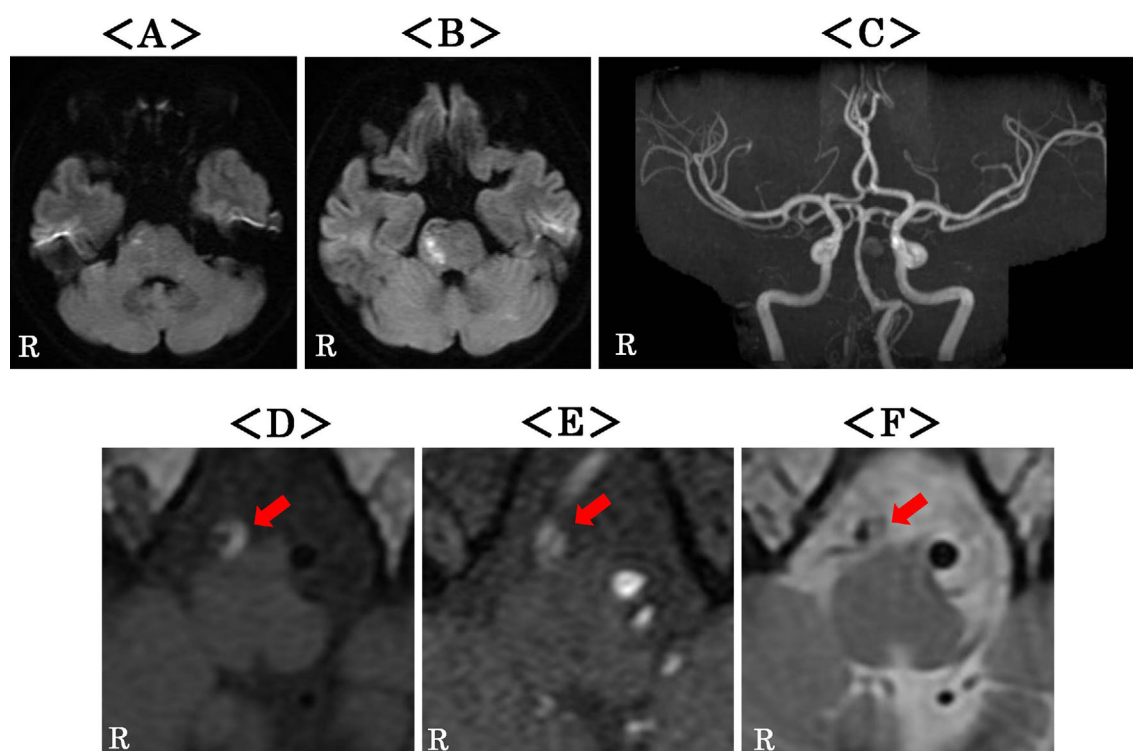


Figure 2. Brain magnetic resonance imaging (MRI) and MR angiography (MRA) on day 4. (A) (B) Diffusion-weighted imaging (DWI) showed multiple punctiform infarcts in the pons. (C) MRA revealed complete recanalization in the basilar artery (BA) from the left vertebral artery (VA), with insufficient recanalization in the right VA. In the brainstem region, (D) MRI showed an intramural dissecting hematoma appearing as a rounded high signal on T1-weighted imaging (arrow). A double-lumen structure appeared on (E) MRA source imaging (arrow) and (F) three-dimensional fast imaging with steady state acquisition (3D-FIESTA) of T2-weighted imaging (arrow). R: right

on MRA source imaging (Fig. 2E) and three-dimensional fast imaging with steady state acquisition (3D-FIESTA) on T2-weighted imaging (Fig. 2F) in the right VA, which are representative signs of VA dissection (9). Therefore, we diagnosed the BA occlusion as thrombosis of the artery leading to artery embolism, resulting from VA dissection. Further investigations were all negative for connective tissue disorders, thrombophilia and vasculitic factors. Transthoracic echocardiography did not indicate any evidence of a cardiac source for the embolism. The patient was started on oral antiplatelet therapy with cilostazol (200 mg/day). She rapidly improved and was discharged on day 20, with minimal ataxia of the right lower limb. On follow-up three months later, she showed no residual neurological deficits.

Discussion

Acute BA occlusion has classically been associated with a poor clinical outcome (10). Several studies have proven that the only relevant factor for achieving a good prognosis in cases of this disease is early recanalization (11, 12). However, treatment with antiplatelet or anticoagulant agents has yielded very low recanalization rates, and intravenous thrombolysis has repeatedly been shown to be poorly effective in attaining recanalization in cases of vertebrobasilar

artery occlusion compared to those affecting other large vessels, such as the internal carotid and proximal middle cerebral arteries (13-15). Therefore, the outcomes in patients with ischemic stroke caused by BA occlusion are highly correlated to recanalization (13, 16). In cases of acute BA occlusion, intravenous thrombolysis achieves timely recanalization in 30-51% of patients (13) and intra-arterial thrombolytic therapy achieves recanalization in 64% of patients (17). In order to improve clinical outcomes, strategies that may improve the rate and speed of recanalization need to be assessed.

Mechanical thrombectomy devices, especially stent retrievers, have been shown to be a new option for the treatment of large-vessel stroke, achieving higher recanalization rates and better clinical outcomes compared with previous treatments (18-20). However, experience with stent retrievers for BA occlusion in the medical literature seems to be quite scarce and primarily includes cases treated with combined therapy, including initial intravenous rt-PA until the DSA sites are prepared, followed by intra-arterial thrombolysis or thrombectomy with stent retrievers associated with the concomitant use of other mechanical devices.

In the most recent study involving mechanical thrombectomy with Trevo stent retrievers for BA occlusion, Espinosa et al. (21) reported 18 cases of BA occlusion, of which

Trevo stent retrievers were used in five cases. In all cases, the patients achieved good outcomes. Reports on the use of other stent retrievers, such as the Merci retriever (Concentric Medical) (5), Solitaire system (ev3 Neurovascular, Irvine, USA) (22, 23) and Penumbra system (Penumbra Inc., Alameda, USA) (23, 24), also showed satisfactory recanalization against BA occlusion. Therefore, when intra-arterial and intravenous thrombolysis fails to achieve successful recanalization, additional mechanical thrombectomy with stent retrievers appears to be relatively efficient. However, to date, there have been no large studies on mechanical thrombectomy for BA occlusion using only the Trevo stent retriever. Moreover, the above studies did not describe vessel dissection, especially of the vertebrobasilar artery.

Acute vertebrobasilar artery occlusion is an uncommon cause of stroke (10). The patient in this case was diagnosed with BA occlusion resulting from VA dissection. Vessel dissection can result in ischemic stroke either from thromboembolism or hemodynamic insufficiency due to severe arterial stenosis or occlusion (25). The best treatment option for VA dissection remains uncertain and controversial (26), and a recent study also failed to demonstrate the superiority of either anticoagulation or antiplatelet therapy (27).

In the present case, the patient presented to the hospital within 30 minutes of the onset of symptoms with a severe and worsening neurological deficit, based on her NIHSS score of 16; therefore, thrombolysis was appropriate. This patient had a poor prognosis, based on her dysarthria, impaired consciousness and severe paresis as a result of basilar artery territory ischemia (28). As the best treatment for arterial dissection remains uncertain, we first administered intravenous rt-PA. However, the severe neurological deficit remained, and we thus next selected endovascular treatment in addition to assessing the precise vessel conditions with DSA. This procedure carries some hemorrhaging risks (29), and indeed our patient showed slight and asymptomatic bleeding in the front of the pons following endovascular treatment.

Because of the expected poor prognosis based on clinical grounds, we undertook an aggressive therapeutic approach in this patient, despite the presence of assumed BA occlusion resulting from VA dissection. Her ultimate good outcome may reflect the smaller size of the brainstem infarcts on post-treatment vs. pre-treatment DWI. Although this patient's results may be atypical, our aim in this report is to underscore that successful recanalization of BA occlusion using additional mechanical thrombectomy after intravenous rt-PA is possible, at least in some instances. The optimal application of this technique must be guided by properly conducted clinical trials with a more accurate diagnosis of the causes of ischemic stroke, including vessel dissection, as mechanical thrombectomy with new stent retriever devices has been demonstrated to be effective for achieving the recanalization of acute cerebral major vessel occlusion (30).

Joe Senda and Tomohide Nishikawa contributed equally to this work.

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