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Case Report

Successful carotid stenting of a carotid arterial dissection after straightening the tortuosity using an inflated balloon guiding catheter and the delivery wire of an anchored stent retriever☆,☆☆

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ABSTRACT

The authors present a patient with carotid dissection in a tortuous arterial segment who successfully underwent carotid artery stenting (CAS) by straightening the tortuosity using an inflated balloon guiding catheter (BGC) and a stent retriever (SR). A 56-year-old man was transferred to our institute with right hemiparesis and a National Institutes of Health Stroke Scale score of 9. Magnetic resonance imaging showed left internal carotid artery (ICA) occlusion and ischemic change in the parietal lobe. Emergent angiography revealed tapered extracranial ICA occlusion sugg carotid artery dissection (CAD). CAS was attempted for CAD due to a mismatch of the motor area on clinical imaging. However, several attempts to navigate the stent delivery system over a guidewire failed. Therefore, we deployed a Trevo NXT ProVue SR (3 × 32 mm) in the middle cerebral artery, inflated a BGC, and then pulled on both to straighten the tortuous carotid artery, which resulted in successful navigation of the stent delivery system. The patient's symptoms improved after the recanalization. This case demonstrates the utility of a technique for navigation of a stent delivery system through a tortuous carotid artery in which the tortuosity is straightened by pulling on an inflated BGC and the delivery wire of the SR.

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Introduction

Stenting for carotid artery dissection (CAD) is often performed in the acute stroke setting [1]. However, severe arterial tortuosity, which is a surrogate marker of subclinical connective tissue disorder, is known to exist in 23%-62% of patients with CAD [2,3]. Therefore, navigation of the stent delivery system into the target artery is sometimes challenging. Here we present a patient with ischemic CAD who successfully underwent carotid artery stenting (CAS) after a tortuous carotid artery was straightened by pulling on an inflated balloon guiding catheter (BGC) and the delivery wire of a stent retriever (SR).

Case report

A 56-year-old man with a history of tobacco smoking was transferred to our institute 6 hours after the onset of right hemiparesis, aphasia, and hemispatial neglect. He had a National Institutes of Health Stroke Scale score of 9. Magnetic resonance angiography (MRA) showed left extracranial internal carotid artery (ICA) occlusion, and diffusion-weighted magnetic resonance imaging (MRI) showed an ischemic change in the parietal lobe (Figs. 1A and B). Emergent angiography showed tapered extracranial ICA occlusion, suggesting CAD with distal thrombus formation (Figs. 1C and D). Left vertebral artery injection showed collateral flow from the adult type of posterior communicating artery and proximal occlusion of the left middle cerebral artery (MCA) M2 segment (Fig. 1E). Because mismatch between the severity of motor deficit and the ischemic lesion sparing motor cortex on DWI suggested impairment of collateral flow in the motor function area, endovascular recanalization was attempted for the extracranial ICA occlusion. Recanalization treatment for occlusion of the M2 inferior trunk was not performed due to robust leptomeningeal flow into the occluded territory. Immediately prior to treatment, the patient was administered 200 mg aspirin and 300 mg clopidogrel through a nasogastric tube. A 9-Fr BGC (OPTIMO EPD FLEX, Tokai Medical Products, Aichi, Japan) was navigated into the cervical ICA. After mechanical thrombectomy with a stent retriever (SR) of thrombus of the carotid artery, A Synchro SELECT support 0.014-inch guidewire (300 cm; Stryker, Fremont, CA) was passed into the true lumen and secured with a microcatheter (Fig. 2A). However, several attempts to navigate a stent delivery system (PRECISE 8 × 40 mm; Cordis, Santa Clara, CA) through the tortuous segment of the carotid artery failed (Fig. 2B). Therefore, a Trevo NXT ProVue SR (3 × 32 mm with a 0.015-inch delivery wire; Stryker, Kalamazoo, MI) was deployed in the middle cerebral artery, and we reattempted to advance the PRECISE stent system over the 0.015-inch delivery wire using the so-called stent anchoring technique (Fig. 2C). However, the attempt failed. Therefore, we inflated the BGC in the proximal portion of the CAD and pulled it back to straighten the tortuous carotid artery, in addition to the stent anchoring technique. Using this method, we finally achieved successful navigation of the stent delivery system over the SR (Figs. 2D and E). Telescopic carotid artery stenting was then performed successfully using 2 PRECISE stents (Cordis; first 8 × 40 mm, second 10 × 40 mm) (Figs. 2F and G). After stenting, Manual forced suction from BGC was performed during releasing proximal protection to prevent distal embolism. SR was withdrawn into an aspiration catheter guided distal to the carotid stents. Postoperative diffusion-weighted MRI showed no new ischemic lesion (H). The patient completely recovered from the hemiparesis and was transferred to a convalescent rehabilitation hospital for treatment of aphasia, with a modified Rankin scale score of 3. Two months after the endovascular therapy, the dual antiplatelet therapy agent was switched to single antiplatelet therapy with aspirin. The patient has been uneventful with a modified Rankin scale score of 3 for 6 months after the intervention.

Discussion

We presented the case of a patient who successfully underwent CAS of a tortuous ICA, and described a method that used both an inflated BGC and a SR to straighten the tortuosity.

The tortuosity of the cervical ICA made CAS challenging due to the inflexibility of the large-profile carotid stent. For this reason, flexible low-profile self-expandable intracranial stents or flow diverter stents have been used through low-profile microcatheters for torturous CAD, despite this being an “off-label” application [4–6]. In the present case, a low-profile stent was too small to achieve appropriate stent apposition because the diameter of the target lesion was 8 mm. Several techniques have been reported for introducing a carotid stent delivery system into a tortuous artery [7,8]. Koge et al. [7] successfully navigated a large-profile carotid stent by straightening a tortuous ICA using a stiff peripheral microguidewire. Koide et al. [8] described a “snake hunt technique’’ in which the kinked vessel was straightened by pull-back of an inflated proximal balloon in the case of proximal vessel kinking after stent deployment for carotid artery stenosis. In the present case, we successfully deployed a carotid artery stent, straightening the tortuous artery by pulling on the proximal carotid artery with a BGC and straightening the delivery wire to navigate the carotid artery stent by the SR anchoring. Although the tortuosity of carotid arteries can be manually corrected in some cases, we did not apply this maneuver due to concern about thrombus migration and extension of the dissecting segment. All carotid stent delivery systems, including PRECISE (Cordis), Carotid WALLSTENT (Boston Scientific, Galway, Ireland), PROTÉGÉ Rx (Medtronic, Minneapolis, MN), and Casper-RX (MicroVention, Aliso Viejo, CA) are compatible with 0.014-inch guidewires. Therefore, navigation of a PRECISE stent over the delivery wire of a Trevo NXT Provue, which is 0.015-inch in size, is off-label use. Anchoring the SR to the M1 segment of the MCA has the risk of vascular endothelial damage. Therefore, this system should be reserved for use only in cases in which navigation of the filter protection devices is challenging.

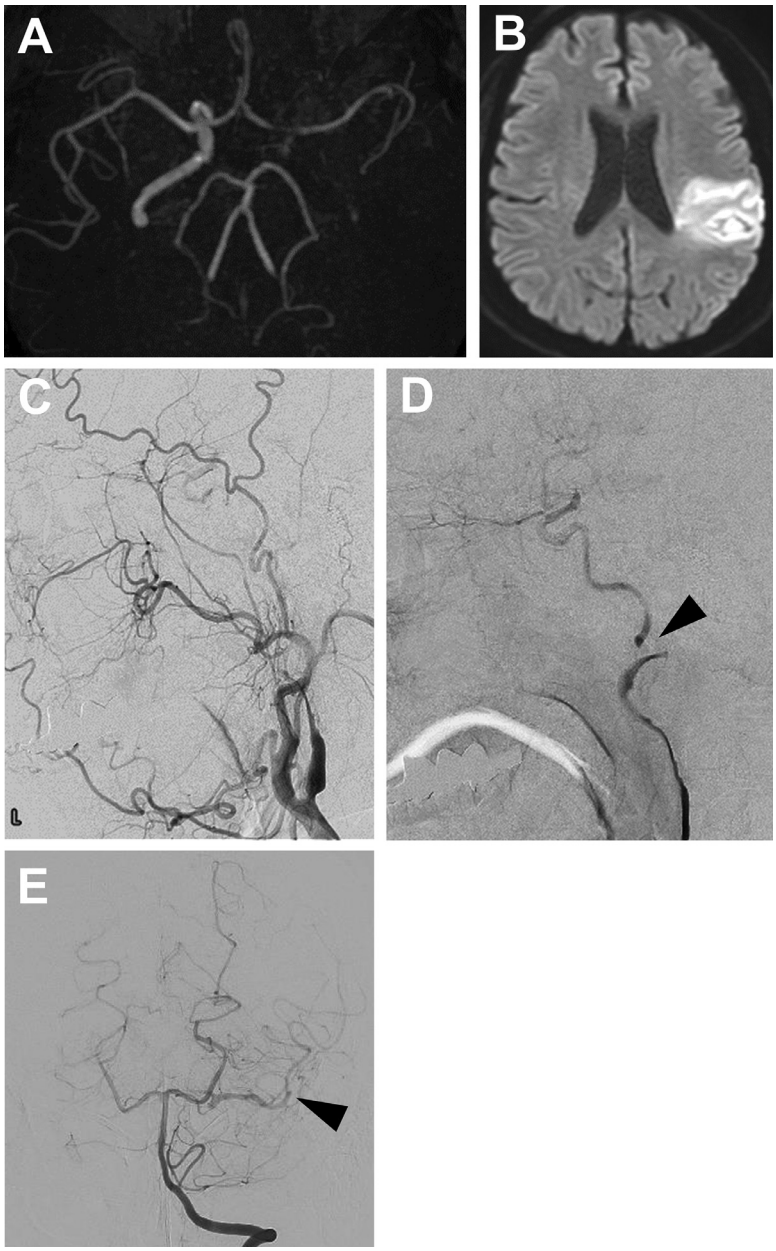

Fig. 1 – (A) Preoperative magnetic resonance angiography (MRA) shows occlusion of the left internal carotid artery (ICA). (B) Preoperative diffusion-weighted magnetic resonance imaging (MRI) demonstrates a high-intensity lesion in the left parietal lobe. (C) The early arterial phase of the left common carotid artery (CCA) injection shows tapered occlusion of the extracranial ICA with collateral flow from the left external carotid artery to the ophthalmic artery. (D) The delayed arterial phase of the left CCA injection demonstrates retrograde flow from the ophthalmic artery to the ascending cervical segment of the ipsilateral ICA, suggesting focal occlusion of the extracranial ICA (arrowhead). (E) Left vertebral artery injection shows collateral supply from the adult type of posterior communicating artery to the left middle cerebral artery (MCA), demonstrating occlusion of the inferior trunk of M2 (arrowhead).

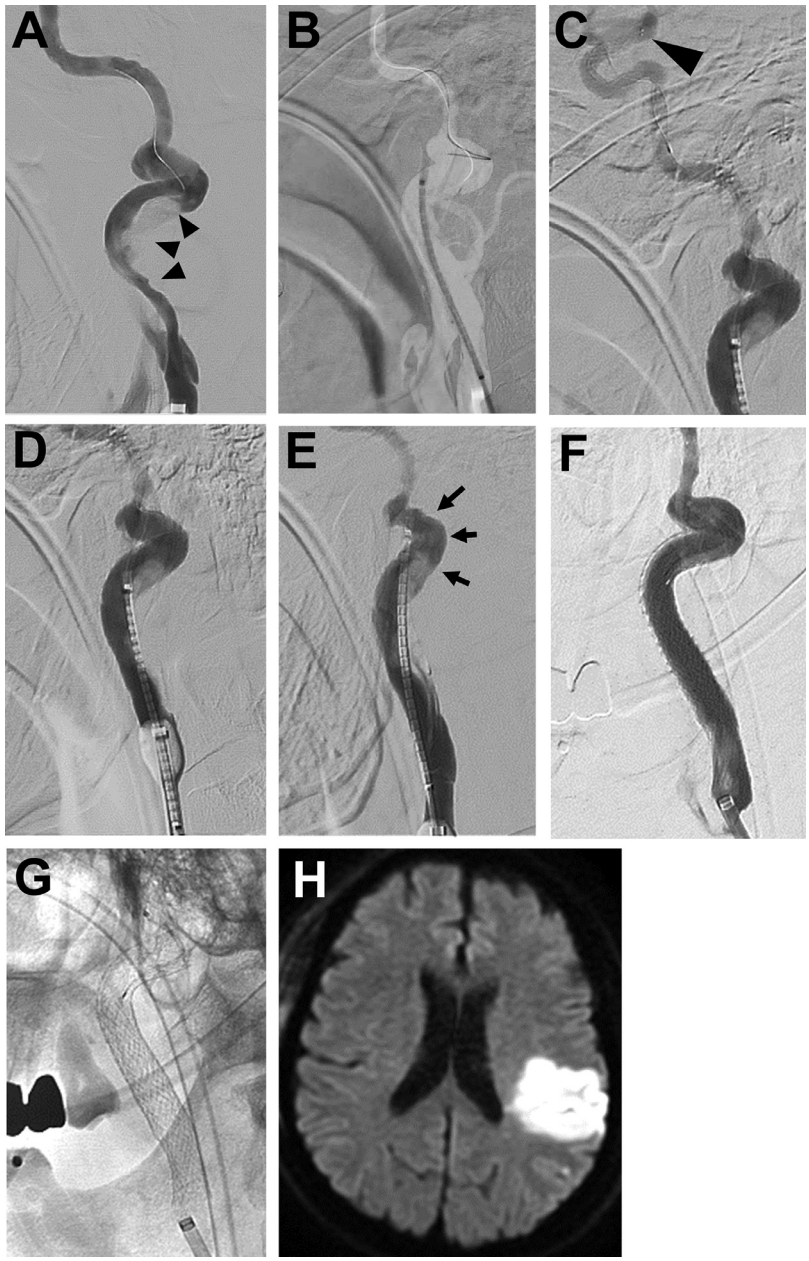

Fig. 2 – (A) Left ICA injection after the first pass of a stent retriever (SR) shows tapered stenosis of the extracranial ICA (arrowheads). (B) Image showing the attempt to navigate the carotid stent system over a 0.014-inch wire. The system could not progress through the tortuous segment of the extracranial ICA. (C) Image showing the attempt to navigate the carotid stent system over the delivery wire of the Trevo NXT Provue 3 × 32 mm SR anchored at the MCA and the ICA (arrowhead). Note the presence of the tortuous trail of the delivery wire of the SR, which prevents the carotid stent system from progressing through the lesion. (D) Image showing carotid artery before pulling the inflated BGC in the proximal portion of the CAD. (E) Image showing the tortuous carotid artery (arrows) straightened by pulling on the inflated BGC and the delivery wire of the SR anchored in the middle cerebral artery. (F) Left ICA injection after deploying 2 PRECISE stents shows complete recanalization of the ICA. (G) Nonsubtracted image demonstrates good stent apposition and complete lesion coverage. (H) Postoperative diffusion-weighted MRI shows no new ischemic lesions.

Conclusion

Our case demonstrated the utility of a technique for navigating the delivery system of a carotid artery stent through a tortuous carotid artery, which is straightened by pulling on an inflated BGC and the delivery wire of the SR.

Human rights statements

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and later versions.

Author contributions

All authors contributed to the medical treatment of the patient and the writing of the manuscript, and have approved the final version of the manuscript.

Patient consent

Informed consent was obtained from the patient for the publication of this case report.

Ethical approval

All information presented in the article is de-identified, including the radiological images. The authors confirm that they have read the journal's position on issues regarding ethical publication and affirm that this report is consistent with those guidelines.

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