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Carotid Artery Stenting Using the Snake Hunt Technique for Highly Tortuous Carotid Artery Stenosis: A Technical Note

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Abstract

In carotid artery stenting (CAS) for highly tortuous carotid stenosis, it is often difficult to guide rigid devices such as carotid stents. There are various adjunctive techniques using a guidewire: the buddy wire technique, the sheep technique, and the stiff guide technique. We report a case in which the tortuous vessel was straightened and a stent could be inserted. A 64-year-old man with amaurosis had highly tortuous left carotid stenosis. Despite the best medical treatments, he often had transient cerebral ischemic symptoms, so we planned CAS. We could insert the first stent, but the proximal vessel was kinked by the placement of the stent. It was so tortuous that the second stent could not be inserted by adjunctive techniques. Therefore, the proximal balloon was inflated and pulled back to straighten the tortuous vessel, and then we could insert the stent. We named this technique the "snake hunt technique" because it was just like catching a snake given that the tortuous vessel was stretched. This technique could be a troubleshooting step when it is difficult to insert a stiff device such as a stent or balloon even with the use of various adjunctive techniques.

Keywords: carotid artery stenting, dissection, tortuous, proximal balloon guiding, buddy wire technique

Introduction

Carotid artery endarterectomy (CEA) and carotid artery stenting (CAS) are two effective treatments for carotid artery stenosis, and the outcomes are similar for both.[1–3] Currently, it is recommended to select the treatment according to the characteristics of the case.[1,4,5] In cases with a difficult access route, CEA is usually performed, but CAS is sometimes performed in cases with other risk factors. CAS for cases with a difficult access route are classified into two types: CAS in which it is difficult to insert a guiding catheter owing to conditions such as aortic disease or a type III aortic arch[6,7] and CAS in which it is difficult to pass a device through a lesion such as severe stenosis or highly tortuous vessels.[4]

For cases in which it is difficult to pass a device through a lesion, adjunctive techniques have been reported such as the buddy wire technique, the sheep technique, and the stiff guide technique.[8–13] In cases of a highly tortuous cervical internal carotid artery (ICA), it is often difficult to guide rigid devices such as carotid stents. We experienced a case of ICA dissection in which a stent was placed by straightening the highly tortuous vessel by the use of a proximal balloon. We here report this technique,

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the snake hunt technique, because it is a very useful method for similar cases.

Case Presentation

A 64-year-old man with a visual field defect visited our hospital.

Head magnetic resonance imaging (MRI) displayed a high-intensity area in the left frontal lobe on the diffusion-weighted images (Fig. 1A). Head magnetic resonance angiography (MRA) showed attenuation of the signal intensity from the left ICA to the middle cerebral artery (MCA) (Fig. 1B). Neck MRA showed stenosis of the extracranial ICA distal to the left ICA bifurcation (Fig. 1C).

After admission, he was conservatively treated with aspirin 100 mg, clopidogrel 300 mg, and atorvastatin 10 mg. ^{123}I-IMP single-photon-emission computed tomography (SPECT) revealed reduced blood flow in the left cerebral hemisphere (Fig. 1D). The left common carotid angiography showed severe tortuosity and stenosis from the left ICA bifurcation to the high cervical portion (Fig. 1E). These examinations suggested ICA dissection. Transient cerebral ischemic symptoms when he stood up appeared even with the best medical treatments, so we planned CAS for the lesion.

Procedure

Under local anesthesia, an 8Fr Optimo catheter (Tokai Medical, Aichi, Japan) was inserted into the left common carotid artery (Fig. 2A). A PercuSurge Guardwire (Medtronic, Santa Rosa, CA, USA) could not be passed through the lesion owing to the vessel being highly tortuous. Therefore, first we passed a FUBUKI 4.2Fr (ASAHI INTECC, Aichi, Japan) through the lesion, and then PercuSurge Guardwire was

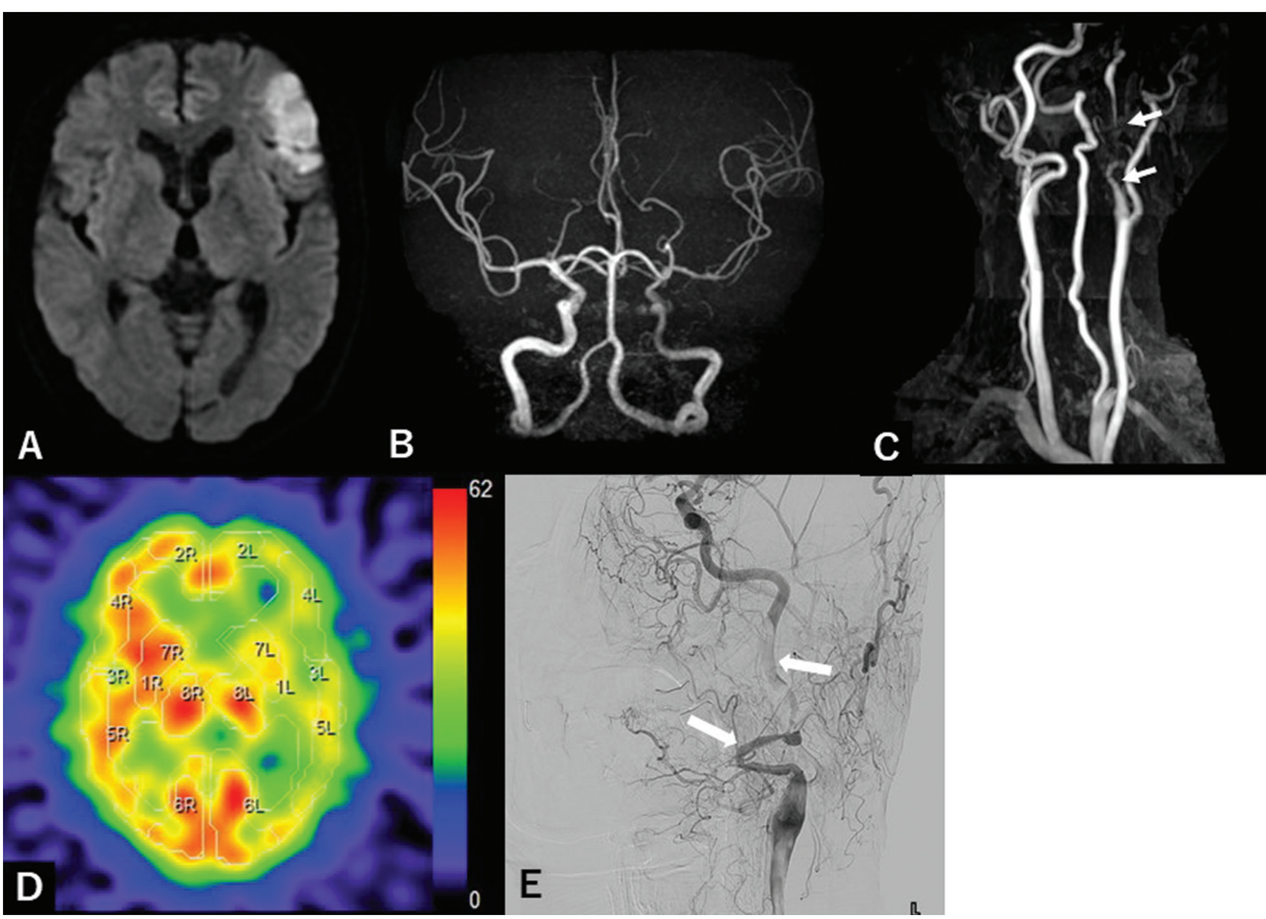

Fig. 1 Diffusion-weighted MRI displays a high-intensity area in the left frontal lobe (A). Head MRA shows attenuation of the signal intensity from the left ICA to the MCA (B). Neck MRA shows stenosis of the extracranial ICA distal to the left ICA bifurcation (C, white arrows). ^{123}I-IMP SPECT reveals reduced cerebral flow in the left cerebral hemisphere (D). Left common carotid angiography (AP view) shows severe stenosis and tortuosity of the left ICA from the bifurcation to the proximal petrous portion of the ICA (E, white arrows). ICA: internal carotid artery, MCA: middle cerebral artery, MRA: magnetic resonance angiography, MRI: magnetic resonance imaging, SPECT: single-photon-emission computed tomography.

deployed (Fig. 2B). A PROTÉGÉ RX 8mm × 60mm (Medtronic) stent was inserted under distal protection and deployed from the petrous portion of the ICA to the proximal portion to cover the stenosis (Fig. 2C). The ICA angioarchitecture changed as a result of the placement of the stent and withdrawal of PercuSurge Guardwire: the ICA proximal to the stent became kinked (Fig. 2D). Therefore, we decided to overlap a stent on the ICA proximal portion. We tried to insert the second stent, a PROTÉGÉ RX 8mm × 60mm, with PercuSurge Guardwire, but the ICA was so tortuous that it became stuck at the proximal end of the first stent. Although we tried to induce the stent by exchanging Spindle XS 0.7 300 cm (St. Jude Medical, St. Paul, MN, USA) for the PercuSurge Guardwire in expectation of straightening the tortuous blood vessel, it was still stuck at the proximal end of the first stent (Fig. 2E). It was necessary to release the flexion of the ICA at the proximal end of the first stent. Therefore, the proximal balloon-guiding catheter was inserted into the origin of the ICA and inflated. Then, it was pulled back to straighten the tortuous vessel (Fig. 2F). Then the second stent could be deployed from the edge of the first stent to the common carotid artery

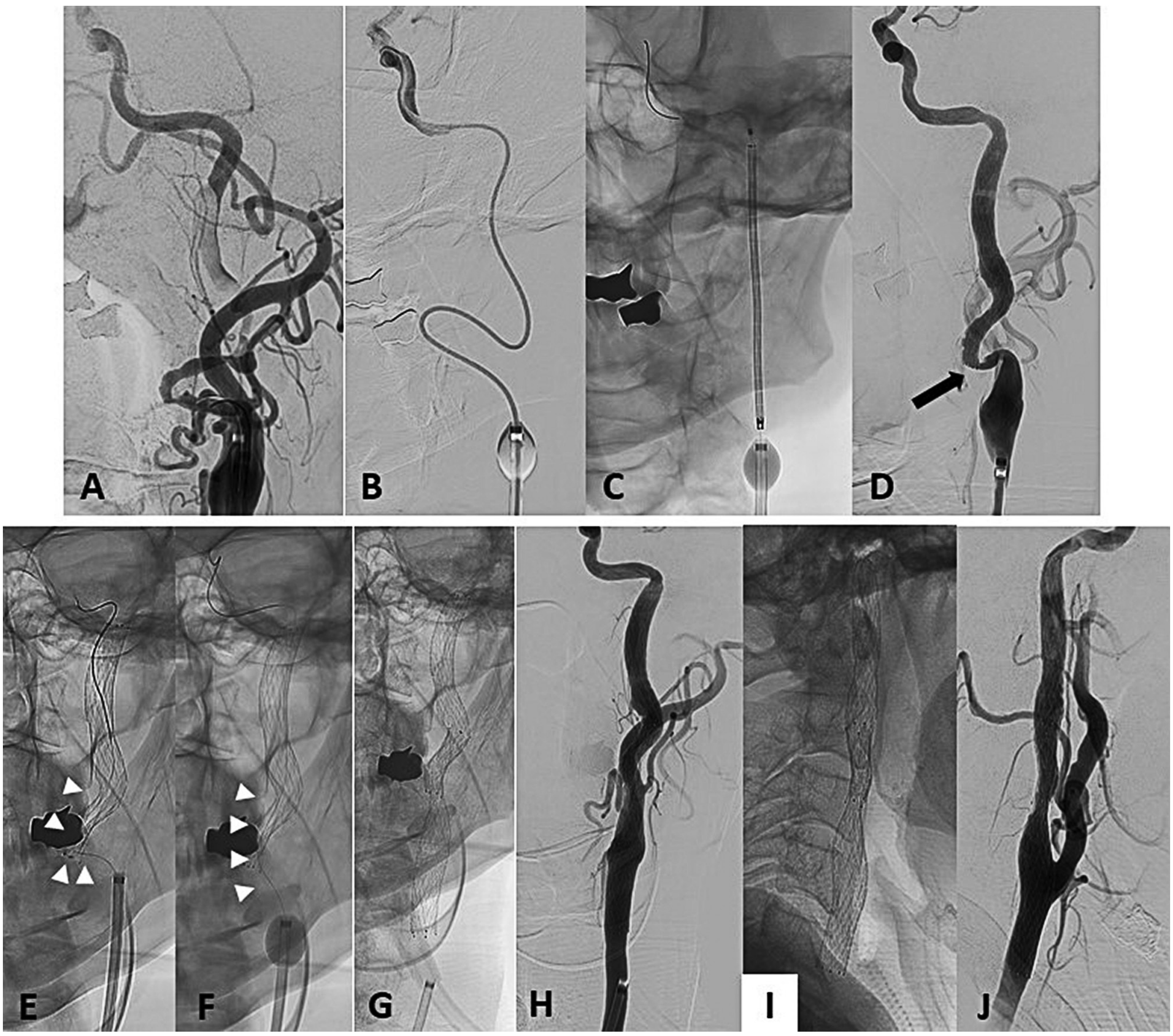

Fig. 2 A balloon-guiding catheter is inserted into the left common carotid artery (A: oblique view). The inner catheter is passed through the lesion (B: oblique view). A distal balloon protection device is exchanged and a stent is inserted under the proximal and distal balloon protection (C: oblique view). The ICA proximal to the stent is kinked by the placement of the stent and withdrawal of the distal balloon protection (D, black arrow: oblique view). The guidewire is exchanged for a stiff guidewire. The balloon-guiding catheter is inflated at the common carotid artery and pulled to straighten the tortuous ICA (E, F, white arrowheads: AP view). The second stent is overlapped on the first stent (G: AP view, I: lateral view). The ICA becomes unkinked and it dilated well, so the stenosis is improved (H: AP view, J: lateral view). ICA: internal carotid artery.

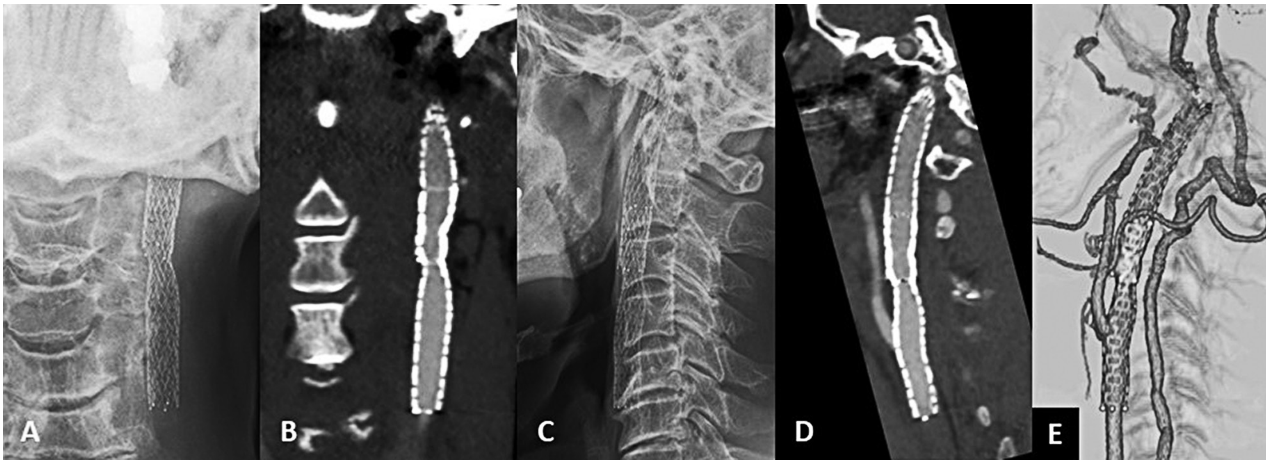

Fig. 3 Radiologic findings on 6 months after the operation. X-ray shows that the stents are straightened and slightly expanded (A: AP view, C: lateral view). Computed tomography angiography shows no restenosis in the stents and common carotid artery stenosis (B: AP view, D: lateral view, E: 3D image).

(Fig. 2G). Final cerebral angiography showed that the vessel had become unkinked and the stenosis was improved (Fig. 2H).

Postoperatively, no new cerebral infarctions or hyperperfusion syndrome was observed. SPECT showed improved blood flow. The patient was discharged with a modified Rankin Scale of 1. The patient's course was uneventful for 6 months after the operation. MRI showed no new cerebral infarction. X-ray showed that the stents were straightened and expanded (Figs. 3A and 3C). Neck computed tomography angiography showed no restenosis in the stents and common carotid artery stenosis (Figs. 3B, 3D, and 3E).

Discussion

CAS for highly tortuous vessels is extremely difficult. As the planned strategy may not go well during the procedure, it is important to troubleshoot in advance. Distal protection devices are less maneuverable than micro guidewires and may be difficult to pass through severe stenosis or tortuous lesions. Several methods have been reported on how to approach tortuous lesions.

Bringing the tip of the guide catheter close to the tortuous vessel and passing through the tortuous vessel with an intermediate catheter are useful methods to insert the protection device in cases with a tortuous vessel.[14] However, it is difficult to pass stiff devices such as stents through the tortuous vessel even with these methods. There are various methods using a guidewire: the buddy wire technique and the stiff guide technique.[8–11] The buddy wire technique provides a stable platform in the subclavian artery for vertebral artery stenting in patients with tortuous vessels. This technique gives additional support to the stability of the guiding catheter.[8] The stiff guide technique also provides greater wire support to the stent catheter and, moreover, straightens the tortuous vessel.[9–11] Although the sheep technique is a method to improve intracranial microcatheter access, it utilizes the feature that a microcatheter tends to preferentially follow a previously placed microcatheter.[12,13]

In the present case, the proximal edge of the first stent was kinked, so the second stent could not be inserted. This phenomenon is thought to make the stent placement more difficult. We tried to insert the stent with the buddy wire technique using a stiff guidewire (Spindle XS) because the ICA was tortuous and the stent could not be inserted well. However, it was still difficult to insert the stent even with the buddy wire technique. Furthermore, when the balloon-guiding catheter was inflated and was pulled under the proximal balloon protection, the tortuous ICA was straightened. This technique allowed the second stent to be inserted. We named this technique the "snake hunt technique" because it was just like catching a snake given that the tortuous vessel was stretched. Changing the shape of the proximal vessel can be useful because the stented vessel is not straightened with a stiff wire. As a technique of CAS for carotid artery stenosis with highly tortuous lesions, this technique could be a treatment option when it is difficult to insert stiff devices such as a stent and balloon despite using various adjunctive techniques.

The use of a distal balloon as an anchor is commonly applied. To the best of our knowledge, this is the first report of this adjunctive technique to pull back the inflated proximal balloon and stretch a highly tortuous vessel. However, because it carries a high risk, this technique should always be used with caution. An ICA dissection case has been reported that was caused by repetitive movement of the balloon guiding catheter during thrombectomy for acute ischemic stroke.[15] The balloon was not bale-shaped dilated but vascular traction was performed with the minimum necessary dilatation. In the present case, a balloon guiding catheter could be inserted into the origin of ICA, but if it can only be inserted into the common carotid artery, embolic protection devices during stent deployment are required. In addition, there is a high risk of performing this technique on vessels with calcification or vulnerable plaques. Since use of stents will become common in neuroendovascular treatment in the future, this could be one of the troubleshooting steps when unexpected tortuous vessels occur.

We used two open-cell stents and the ICA became straightened. Carotid angiography showed no accordion effect in either the common carotid artery proximal to the stent or the ICA distal to the stent. Therefore, it was speculated that the vessel at the placement of the stent shortened like bellows. Although that was not identified in a search of the literature, special care is required for stent deployment for highly tortuous vessels.

Informed Consent

Informed consent has been obtained from the patient for publication of the case report and accompanying images.

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Conflicts of Interest Disclosure

We declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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