Two Cases of Carotid Artery Stenting Combined Balloon- and Self-expanding Stent for the Spontaneous Internal Carotid Artery Dissections

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Objective: Although conservative treatment is the first choice for high cervical internal carotid artery (ICA) stenosis due to spontaneous cervical ICA dissection, surgical revascularization is necessary when the disease resists conservative treatment. Although such lesions are difficult to treat by conventional carotid endarterectomy (CEA) or carotid artery stenting (CAS), they may be treated less invasively by modified CAS with add-on devices. In this report, we present two cases of CAS performed by the combined use of balloon- and self-expanding stents with a review of the literature.

Case Presentations: Revascularization was performed by the same procedure in a 47-year-old man and a 43-year-old woman with left high cervical ICA stenosis. In the first case, no restenosis was noted on follow-up DSA performed after 1 year, but the self-expanding stent that initially overlapped the balloon-expandable stent had slipped off.

Conclusion: High cervical carotid artery stenosis due to spontaneous cervical ICA dissection can be treated by CAS using the proximal protection technique with the combined use of a balloon-expandable stent.

Keywords ▶ carotid artery stenting, balloon-expanding stent, carotid artery dissection, spontaneous

Introduction

In Japan, spontaneous cervical internal carotid artery (ICA) dissection is a relatively rare disease, and conservative treatment is the first priority for its management. However, patients, who resist medical treatment, show exacerbation of symptoms, or have circulation disturbance may have indications for stent therapy.1,2) ICA dissection may occasionally extend to a high position near the carotid canal, and is difficult to treat by carotid endarterectomy (CEA), but may be treated by carotid artery stenting (CAS) with modified technique. But in the cases in which dissection extended near the carotid canal, self-expanding stent is often difficult to be navigated and deployed at targeting position through the torturous vessel. In this report, we present two cases in which CAS was performed by the combined use of a balloon-expandable stent for spontaneous cervical ICA dissection.

Case Presentations

Case 1

The patient was a 47-year-old male with transient weakness and numbness of the right upper and lower extremities. He had a history of hypertension, hyperlipidemia, and hyperuricemia.

He had experienced a few seconds weakness of the right lower extremity 9 months before. Thereafter, he noted weakness and numbness of the right upper extremity, was diagnosed with subacute infarction of the left frontal lobe and spontaneous dissection of the left cervical ICA at a local neurosurgery clinic, and was referred to our department.
On admission, no neurological deficits were observed. At the previous clinic, a high-intensity area was noted in the deep white matter of the left frontal lobe on diffusion-weighted imaging (DWI) (Fig. 1A). MRA showed marked stenosis in the craniocervical junction of the left internal carotid artery (ICA) (Fig. 1C), and resting $^{123}$I IMP SPECT indicated reduced cerebral blood flow in the left ICA area (Fig. 1B).

We diagnosed spontaneous cervical ICA dissection at the craniocervical junction, and revascularization was selected because of the low cerebral blood flow (CBF). Since treatment using a conventional CAS using self-expanding stent was considered difficult due to the high cervical ICA stenosis, CAS combined using a balloon-expandable stent was selected. After our conference about the off-label use of the device, informed consent was obtained from the family. Dual-antiplatelet therapy (DAPT) consisting of 200 mg cilostazol and 75 mg clopidogrel was performed from 1 week before the procedure.

Under local anesthesia, a 9 Fr balloon guiding catheter was placed in the left common carotid artery, and the left external carotid artery was occluded by placing a guard-wire (GW) (Medtronic, Santa Rosa, CA, USA). A 0.014-inch micro-guidewire was carefully guided through the lesion and advanced to the cavernous portion (Figs. 2A and 2B). After blocking the common carotid artery, the flow reversal protection was performed using the venous sheath. A Palmaz genesis (Johnson & Johnson, Miami, FL, USA) $5 \text{ mm} \times 18 \text{ mm}$ was placed distally to the lesion, and a Wallstent (Stryker, Kalamazoo, MI, USA) $10 \text{ mm} \times 21 \text{ mm}$ was placed with about 6-mm overlap with the Palmaz (Fig. 2D). Blocking of the blood flow was released after sufficiently flowing debris to the venous side. Post-dilation was performed using a percutaneous transluminal angioplasty (PTA) balloon $5 \text{ mm} \times 40 \text{ mm}$. The anterograde flow of ICA was improved, and satisfactory delineation of ICA was observed (Fig. 2C).

Postoperatively, there was no new neurological symptoms, no new cerebral infarction was detected by DWI, and the patient was discharge to home. Follow-up DSA performed after 1 year showed adequate patency but displacement of the overlapping stent (Fig. 2E).

**Case 2**

The patient was a 43-year-old woman complaining of a sudden onset headache and she visited a neurosurgery clinic. MRI demonstrated left vertebral artery dissection and spontaneous left cervical ICA dissection, and she was referred to our hospital for treatment.
Two Cases of CAS Combined Balloon- and Self-Expanding Stent

Of the common and external carotid arteries, pre-dilation was performed using a Gateway (Stryker) 3 mm × 12 mm, and a Palmaz genesis 5.0 mm × 18 mm was placed (Fig. 4C). In addition, a Wallstent 8 mm × 21 mm was placed by overlapping about half of its length with the Palmaz (Fig. 4D). Since the vessel was dilated to a sufficient diameter in placing the Wallstent, post-dilation was not performed.

Postoperatively, the patient was discharged to home without new neurological symptoms. Adequate patency of the stent was confirmed by DSA 1 year after the treatment.

Discussion

The incidence of spontaneous cervical ICA dissection in Japan has been reported to be 1–1.5 per 100,000 persons, which is about 1/2 of that in Western countries, and it is also lower than the incidence of vertebral artery dissection with a ratio of about 1:4. However, the recent improvements in diagnostic imaging may make more chance to diagnose the ICA dissection. An onset with hemorrhage is very rare, and with ischemia is usually. While conservative treatment is the first choice, surgical intervention is selected in patients with unstable hemodynamics. Direct...
Fig. 3  (A–C) Diffusion-weighted MR images show ischemic lesion in the left watershed lesion. (D and E) Intracranial and neck MRA show the decreased signal in the left ICA area and the dissecting aneurysm in the left VA (arrows). (F) SPECT shows no CBF laterality in this brain. CBF: cerebral blood flow; ICA: internal carotid artery; SPECT: Single Photon Emission Computed Tomography; VA: vertebral artery

Fig. 4  (A) The preoperative left common carotid angiogram shows the severe stenosis in cranio-cervical lesion caused by dissection (AP view). (B) The external carotid artery was occluded by GW and the micro-guidewire is passing through the true lumen. (C) The postoperative angiogram (AP view) shows complete restoration of the vessel profile. (D) Xp shows the Wallstent was placed so as to overlap the Palmaz stent sufficiently. AP: anteroposterior; GW: guard-wire

procedures including extracranial–intracranial (EC-IC) bypass were reported in the past, but treatment has shifted recently to less invasive stent therapy. According to the report by Jeon et al., all eight patients with cervical carotid artery dissection treated by stenting had favorable outcomes.

We experienced two cases of spontaneous cervical ICA dissection which were treated by combined a balloon- and a self-expanding stent. We should use only a self-expanding stent because national health insurance in Japan cover only it to treat the carotid artery stenosis. However, in the cases it is often difficult to be navigated and deployed at the end of stenosis using a self-expanding stent because of the tortuous vessel. The use of a Palmaz Genesis, which is a balloon-expandable stent for the renal artery, is not recommended for cervical artery lesions. However, balloon-expandable stents
are highly flexible and passable,29 and was placed easily and appropriately in patients with spontaneous cervical internal artery dissection. In Japan, Wingspan (Stryker) is covered by insurance as an intracranial stent, but its use is presently difficult due to strict facility rules and indications. There have been reports of the use of coronary stents2,8,11 and Palmaz,9,11 and their use is considered to be ethically permissible if an appropriate approval procedure is followed.

Concerning Case 1, a Palmaz and a Wallstent were overlapped by 6 mm, but the Wallstent slipped off the Palmaz on DSA after 1 year. This disengagement was considered to have been due to the lack of the distance of overlapping or gradual shortening of the Wallstent due to its self-expandability. Particularly, while we used a 10-mm Wallstent in consideration of the diameter of the ICA at its bifurcation, an 8-mm Wallstent may have also been a choice. It was also considered necessary to increase the length of overlapping as much as was technically possible. Because of the etiology of dissection, a closed-cell stent may be the first choice because the stent strut may keep the dissection wall and the thrombus outside the stent than an open one,2,10 but the use of an open-cell stent, which is less likely to shorten, may also be a reasonable choice.

Case 2 had the onset with left-sided headache and simultaneously suffered dissection of the left internal carotid and left vertebral arteries. Cerebral infarction was limited to the left ICA area, the time of the onset of left vertebral artery dissection was unknown, and no sign of acute dissection was observed on MRI. Therefore, we should have treated the left ICA dissection without the parent artery occlusion of the left vertebral artery dissection. However, the left vertebral artery dissection was treated, since we were concerned about the rupture of it, because of mildly high-pressure treatment. Headache may also be caused by ICA dissection, and, according to the report by Anson et al.,13 59% of the patients of ICA dissection complained of headache.

Regarding the surgical procedure, there have been some reports of distal protection using a GW and filter devices,2,8,12 but we considered proximal protection using a micro-guidewire to be preferable because of its good performance about the navigation to the tortuous vessel and the security to the true lumen. For this purpose, we consider a balloon guiding catheter and, more recently, Mo.Ma Ultra (Medtronic) is appropriate.

In the postoperative follow-up, carotid artery ultrasonography plays a major role after conventional CAS, but the evaluation to a sufficiently distal region is impossible. Since MRI does not evaluate restenosis, we consider periodic follow-up by DSA or 3D-CTA to be necessary.

## Conclusion

Two cases of spontaneous cervical ICA dissection treated by the combined use of a balloon-expandable stent were reported. Even ICA dissections at a high position, which are difficult to treat by conventional CEA or CAS, could be treated by it. Despite the lack of insurance coverage, treatment could be performed by nearly the same procedure as usual CAS with proximal protection. Mildly invasive stenting is considered to be a useful treatment option to high cervical ICA dissection.

## Disclosure Statement

There are no conflicts of interest to disclose regarding this paper.

## References


