### Objective:
The patient had symptomatic right carotid artery dissection due to extension from aortic dissection who underwent stenting via the right brachial artery approach.

### Case:
A 61-year-old male underwent emergency operation for Stanford A type aortic dissection, but developed cerebral infarction due to extension of the dissection to the right carotid artery after the operation, and underwent stenting via the right brachial artery approach for the prevention of recurrence. A 6-Fr Simmons type Axcelguide was inserted, and stenting was performed with two Carotid Wallstents in conjunction with the Filterwire EZ. He showed a favorable postoperative course and was discharged home.

### Conclusion:
When extension of dissection to the right subclavian artery is absent, stenting using the right radial artery approach should be considered as a safe procedure.

### Keywords
- aortic dissection
- cerebral infarction
- carotid artery stenting
- brachial artery approach

### Introduction
Aortic dissection is a surgical emergency, and has a high mortality rate even when early therapeutic interventions are performed.\(^1,2\) In particular, since Stanford A type aortic dissection affecting the ascending aorta and aortic arch may extend to branches, such as the common carotid artery, cerebral ischemia as a complication occurs in about 6%–20% of patients with this type, and it is recognized as an important prognostic factor.\(^3,4\) There have been some studies in which common carotid artery dissection due to extension from aortic dissection was treated by carotid artery stenting via the femoral artery approach, and favorable results were obtained. However, using this approach, since the device passes the aortic dissection site, there is a risk of bleeding due to catheter entrance into the false channel.\(^4,7\)

We performed a carotid artery stenting via the right brachial approach in a patient with symptomatic right common carotid artery dissection due to extension from aortic dissection, and favorable results are obtained.

### Case Presentation
Patient: A 61-year-old male
Chief complaint: Paresthesia in the left upper limb
Past history: Hypertension, hyperlipidemia, and cholecystitis
Present illness: He underwent an emergency Bentall operation for acute aortic dissection (Stanford A type) at the Department of Cardiovascular Surgery in our hospital. Preoperative three-dimensional computed tomography angiography (3D-CTA) showed extension of dissection to the brachiocephalic trunk. After the operation, thrombosis of the false channel and associated slight compression of the true channel were observed. However, since the postoperative course was favorable, he was discharged 2 weeks after the operation. One month after the discharge, paresthesia in the left upper limb suddenly developed. Magnetic resonance imaging (MRI) of the head revealed acute cerebral infarction involving the right temporal lobe, insular
gyrus, and parietal lobe (Fig. 1), and 3D-CTA of the neck showed dissection extension to the right carotid artery and thrombosis of the false channel (Fig. 2).

**Treatment principles**

This patient had cerebral infarction due to occlusion of a branch of a major cerebral artery, and the mechanism of the infarction was considered to be artery-to-artery embolization by a thrombus in the false channel. Although endovascular treatment was also considered as a treatment choice, since aortic dissection extended to the bilateral common iliac arteries beyond the abdominal aorta (Fig. 3), the femoral artery approach to the lesion appeared to be difficult. Thus, initially, to prevent the recurrence of embolism, anticoagulation therapy with heparin as a conservative method was performed. However, 1 week after admission, left hemiparesis is newly developed, and MRI of the head revealed a new cerebral infarction in the right frontal lobe. Therefore, 3D-CTA from the neck to lower limbs was performed again, but no morphological changes were observed in the dissection lesion in the right carotid artery. As a result of the re-evaluation, the following treatment principles were decided. Carotid artery stenting extending to the common carotid artery is performed, including the re-entry site in the right internal carotid artery to prevent thrombus scattering and assure the true channel of the common carotid artery as proximally as possible.

**Endovascular treatment**

After loading of aspirin (200 mg) and clopidogrel (300 mg) as antiplatelet agents so as to be able to perform emergency treatment anytime at the time of re-recurrence, aspirin (100 mg/day) and clopidogrel (75 mg/day) were consecutively administered for 5 days, and elective treatment was performed. Under local anesthesia, a 4-Fr short sheath was inserted into the right brachial artery, and replaced by a 6-Fr Axcelslide (Medikit, Tokyo, Japan) for the possible use of wider stents (Fig. 4A). We attempted to insert a Radifocus 0.035 guidewire (Terumo, Tokyo, Japan) into the right common carotid artery using a 6-Fr Cerulean G (Medikit) as a coaxial catheter. However, since the shape of the catheter was inappropriate, the catheter was changed to a 4-Fr Simmons type coaxial catheter, and guidance became possible (Fig. 4B). Since preoperative 3D-CTA images showed the absence of dissection extension to the right subclavian artery and the presence of continuity between this artery and the true channel (Fig. 5), we considered that direct guidewire advancement from the right subclavian artery to the true channel is possible, and did not use ultrasonography or intravascular ultrasound (IVUS). Angiography was performed when necessary, and the area that appeared to be the true channel was selected; the guidewire was advanced slightly distal to the right carotid artery branching beyond the re-entry site of dissection in the right internal carotid artery. We gave more importance to reduce the risk of device entrance into the false lumen than to reduce the risk of embolism associated with catheter guidance by placing the protection device first. As a result, the Axcelslide was advanced to a site distal to the re-entry site first. Due to the long time from the development of dissection, thrombus organization in the false channel was considered. Therefore, a distal filter protection, not a distal balloon protection,
were placed so as to cover the false channel as proximally as possible, including the re-entry site (Figs. 4C and 4D). At this time point, although the dissection at the proximal site of the common carotid artery and brachiocephalic trunk remained, further stent placement via the guiding catheter...
site was difficult. The recovered Filterwire EZ showed no clear debris attachment. Finally, stent patency and the absence of intracranial artery occlusion were confirmed by angiography, and the procedure was completed.

**Postoperative course**

After the operation, there was no aggravation of neurological findings. The postoperative course was favorable, and rehabilitation was performed for the remaining mild left hemiparesis. He was discharged home 3 weeks after the operation in the state of modified Rankin Scale 1, and has been treated at the outpatient clinic of our hospital. Carotid artery 3D-CTA and carotid artery ultrasonography 6 months after the operation showed good stent patency and almost complete repair of the dissection of the common carotid artery and brachiocephalic trunk proximal to the stent (**Fig. 6**).
**Discussion**

Stanford A type aortic dissection requires early surgical interventions, and its extension to the carotid artery is associated with a high complication rate of cerebral ischemia. Of patients who underwent surgical repair, such as the Bentall procedure, 15%–51% have been reported to have residual carotid artery dissection that frequently involves the right side. Zielinski et al. observed dissection extension to the carotid artery in 15 (15%) of 97 survivors after surgery for aortic dissection but no late neurological abnormalities in any survivor. On the other hand, Neri et al. observed residual carotid artery dissection in 42 of 137 patients after surgery for aortic dissection and late neurological events occurred in 13 (30.9%), recommending strict follow-up. At present, there are no definite criteria for indications for endovascular treatment for the extension of aortic dissection to the carotid artery. Considering severe treatment-associated complications, such as embolism, extension of dissection, and vascular rupture, endovascular treatment should be performed only in limited cases. Cohen et al. performed stenting in 23 patients with cervical carotid artery dissection based on the following indications: 1) presence of contraindications for anticoagulation therapy such as intracranial bleeding, 2) no response to anticoagulation therapy performed alone (repetitive attacks of transient cerebral ischemia), 3) hemodynamic instability, such as poor collateral circulation and occlusion or severe stenosis in the contralateral carotid artery on MRI images or angiograms, and 4) need for both intracranial vascular reconstruction and simultaneous extracranial vascular treatment. As a result, he observed no severe complications during the operation and neither stroke nor de novo in-stent thrombosis/stenosis during a mean postoperative follow-up period of 28.7 ± 31.9 months. Pham et al. performed meta-analysis in 140 patients in 31 studies on stenting for carotid artery dissection, and reported a technical success rate of stenting of 99%, procedural complication rate of 1.3%, mean postoperative follow-up period of 12.8 months, and in-stent stenosis or occlusion rate of 2%.

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**Fig. 6** Echography of the right carotid artery (A and B) and cervical 3D-CTA (C) 6 months after the endovascular treatment. (A) The patency of the stent is favorable and the intimal flap is not apparent. (B) There is no evidence of blood flow to the false channel. (C) The dissection of the brachiocephalic artery and the proximal right common carotid artery is almost repaired spontaneously. 3D-CTA: three-dimensional computed tomography angiography
Based on these reports, stenting for carotid artery dissection can be relatively safely performed if its indications are limited, and endovascular treatment should be considered at least in patients, such as our patient, with progressive cerebral infarction or repeated attacks of transient cerebral ischemia.

In endovascular treatment for the extension of aortic dissection to the carotid artery, the access route to the lesion is the most important. Before operation, 3D-CTA from the neck to the lower limbs should be performed for detailed evaluation. If aortic dissection involves a large area from the chest to the abdomen, an approach through the femoral artery has a risk of guidewire or catheter entry into the false channel, inducing fatal hemorrhagic complications, and careful attention is required when the device is advanced. Casana et al.\(^1\) reported that safer device advancement is possible by advancing the device while the true channel is confirmed using transesophageal ultrasonography. This method may be useful, but when the true channel is extremely narrow on preoperative images, and guidewire passage is expected to be difficult, the brachial artery approach, which does not require the passage through the thoracoabdominal aortic dissection portion, can markedly reduce the risk of catheter entrance into the false channel. On the other hand, for left common carotid artery or left subclavian artery lesions, device manipulation via the aortic arch is necessary, and the right brachial artery approach is difficult depending on the state of the dissected portion. Therefore, after detailed evaluation of preoperative images, the most adequate approach should be selected.

Many previous studies have shown that the concurrent use of an embolic protection device (EPD) is not necessary for carotid artery stenting for the extension of dissection to the carotid artery. Cardaioli et al.\(^1\) described the following reasons: 1) EPD deployment in the false channel involves the risk of additional complications and 2) since many dissections become a blind end at the distal end, cerebral ischemia is not caused by distal embolism but due to a hemodynamic mechanism. However, Neri et al.\(^1\) reported that 24.1% of patients with residual carotid artery dissection were positive for the microembolic signal using transcranial Doppler monitoring, and this signal was significantly associated with late cerebral infarction as a complication. In the patient in this study, we strongly suspected embolic cerebral infarction due to a thrombus formed in the false channel detected by preoperative diagnostic imaging and therefore performed the serial procedure using the Filterwire EZ to prevent distal embolism during the operation. When preoperative head MRI strongly suggests cerebral infarction due to distal embolism, and 3D-CTA, ultrasonography, and MRA of the carotid artery suggest thrombus formation in the false channel, and the use of EPD should be considered.

Concerning the serial treatment procedure in this study, we did not use IVUS or percutaneous ultrasonography when advancing the guidewire or catheter. However, these imaging techniques are extremely useful for identifying the true channel, and should have been used to perform the procedure more safely. In particular, when the lesion is passed, the advancement of the guiding catheter prior to the protection device involves marked risks. Thus, we should have advanced the protection device before guiding catheter advancement, or at least should have advanced the catheter while confirming the true channel using IVUS or transcutaneous ultrasonography. In this study, distal filter protection was used, but in terms of the prevention of distal embolism, distal balloon protection may have been more accurate.

### Conclusion

For the extension of aortic dissection to the carotid artery, active treatment should be considered in patients with progressive cerebral infarction or frequent attacks of transient cerebral ischemia. The usefulness of carotid artery stenting by endovascular treatment has been reported. In particular, for lesions in the right carotid artery, the right brachial artery approach should be considered in terms of safety. When this approach is used, it is desirable to perform the procedure while the true channel is confirmed using percutaneous ultrasonography or IVUS.

### Disclosure Statement

The authors have no conflicts of interest to disclose concerning this study.

### References


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