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Technical Note

Buddy Catheter Technique: A Method of Guiding the Mo.Ma Ultra into a Left Common Carotid Artery That Branches off the Aortic Arch at a Steep Angle

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Objective: The Mo.Ma Ultra is an embolic protection device used in carotid artery stenting (CAS). In cases of left internal carotid artery stenosis (ICS) in which the common carotid artery (CCA) branches off the aortic arch at a steep angle, insertion of the Mo.Ma Ultra into the CCA is sometimes difficult. We introduce a "buddy catheter technique" that helps guide the Mo.Ma Ultra into the CCA, with an additional 4 Fr catheter into the external carotid artery.

Case Presentation: An 84-year-old man with left ICS whose CCA also branched off the aortic arch at a steep angle also underwent CAS. The "buddy catheter technique" was used, and the Mo.Ma Ultra was inserted smoothly. The buddy catheter technique displaces the left CCA upward. Displacement straightens the vessels anatomically, and the ledge effect can be prevented by aligning the course of the vessels with the wire. Nevertheless, this technique requires bilateral femoral puncture, and so, complications can occur.

Conclusion: The buddy catheter technique may be considered in cases in which the left CCA branches off the aortic arch at a steep angle.

Keywords ▶ internal carotid artery stenosis, carotid artery stenting, Mo.Ma Ultra, buddy catheter technique

Introduction

Carotid artery stenting (CAS) was introduced as an alternative to carotid endarterectomy for the treatment of internal carotid artery stenosis (ICS). In the past decade, various devices for CAS have been developed, and multiple trials have demonstrated that its efficacy and safety are comparable with those of carotid endarterectomy.[1–3] The Mo.Ma Ultra (Medtronic, Minneapolis, MN, USA) was introduced as a protection device to stabilize blood flow in the carotid artery by occluding the common carotid artery (CCA) and external carotid artery (ECA) with balloons before the carotid stenotic lesion is crossed. The ARMOUR pivotal trial revealed the safety and efficacy of the Mo.Ma Ultra.[4] Additionally, the manufacture of a distal balloon protection device, the Carotid GuardWire (Medtronic), was discontinued; consequently, the use of the Mo.Ma Ultra with filter distal protection devices is increasingly required.

The majority of the patients who undergo CAS tend to have arteriosclerosis with tortuous vessels, which are sometimes characterized by steeply angled vascular branches. In such cases, insertion of the Mo.Ma Ultra may be technically difficult. Additionally, to insert the Mo.Ma Ultra into the ECA, we use an exchanging method with a super-stiff (Boston Scientific, Marlborough, MA, USA) or extra-stiff guidewire (Cook Medical, Bloomington, IN, USA), and the tip of the guidewire must be guided to the distal portion of the ECA. Within tortuous vessels, manipulation of the super-stiff guidewire is often difficult. Through the femoral approach, the support of a super-stiff guidewire may not be sufficient to insert the Mo.Ma Ultra.

In the following case, we describe our buddy catheter technique, in which the CCA is given additional support

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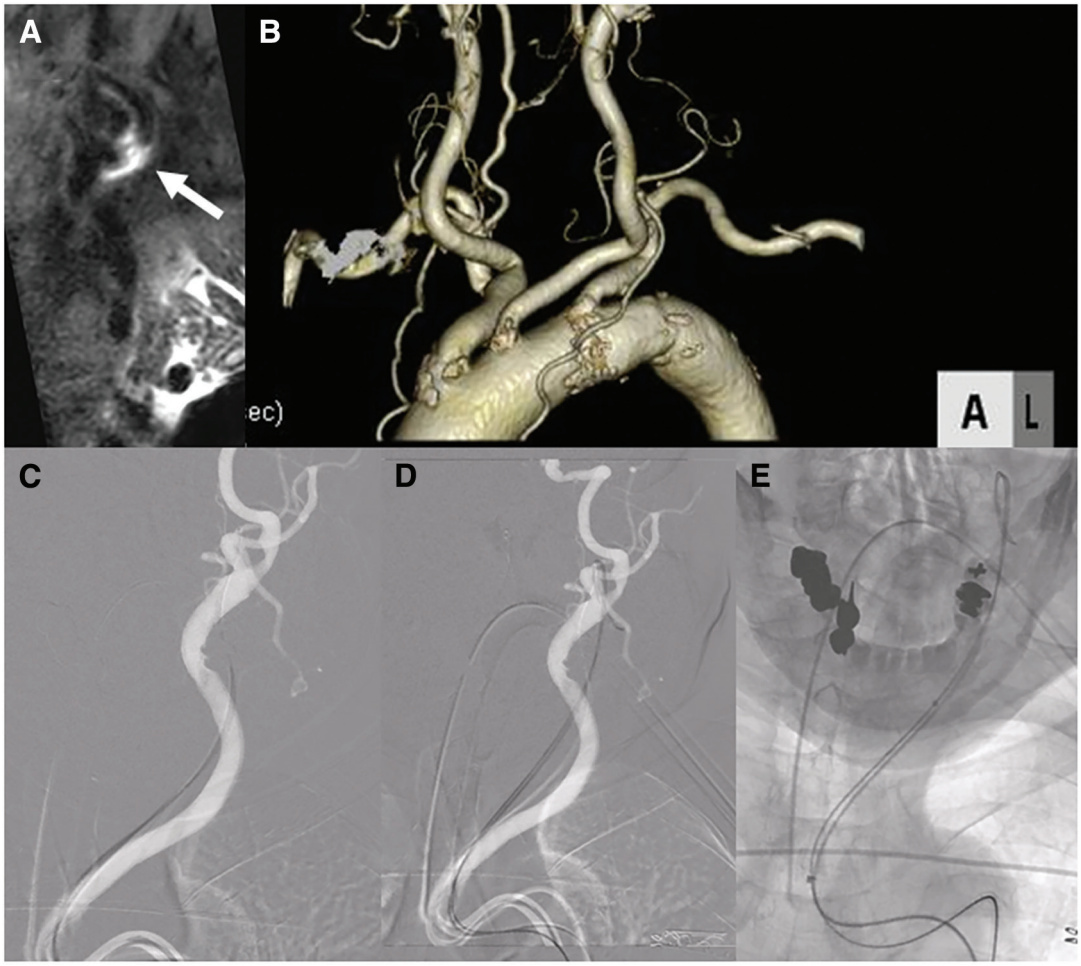

Fig. 1 (**A**) T1-weighted black-blood MRI of the left carotid artery. Plaque was visualized in high intensity, suggesting that it was a vulnerable plaque (arrow). (**B**) Preoperative CTA of the aortic arch. The left CCA branches off the aortic arch at a steep angle. (**C**) A 4 Fr SY3 catheter with a half-stiff wire was inserted into the ECA. The left CCA was displaced upward. (**D**) A 6 Fr catheter was inserted into the ECA and an extra-stiff wire was inserted into the 6 Fr guiding catheter. The access route was further straightened. (**E**) The Mo.Ma Ultra was inserted smoothly into the CCA. CCA: common carotid artery; ECA: external carotid artery

and the approach route is further straightened, which facilitates the insertion of the Mo.Ma Ultra.

Case Presentation

An 84-year-old man presented with right hemiplegia, aphasia, and left conjugate eye deviation. MRI demonstrated diffuse fresh cerebral infarctions in the regions of the left middle cerebral artery and posterior cerebral artery. CTA demonstrated left ICS and a decrease in perfusion in the left cerebral hemisphere in comparison with the right side. The cerebral infarction was treated with antithrombotic therapy. Carotid duplex ultrasonography depicted vulnerable plaque and a peak systolic velocity (PSV) of 220 cm/s. DSA showed 75% stenosis according to the North American Symptomatic Carotid Endarterectomy Trial (NASCET) method and an ulcerated lesion. T1-weighted black-blood MRI of the left carotid artery also showed high-intensity plaque (**Fig. 1A**). Preoperative whole-body CTA also showed the left CCA branching off the aortic arch at a steep angle (**Fig. 1B**). The patient received 75 mg of clopidogrel, 100 mg of aspirin, and 100 mg of cilostazol daily as preoperative treatment.

We expected the insertion of the Mo.Ma Ultra into the left ECA to be difficult in this case. We used the buddy catheter technique, which applies the buddy wire technique, to straighten the angle of the CCA as it branches off the aortic arch so that the Mo.Ma Ultra could be advanced.

The operation was performed with the patient under general anesthesia. Through a femoral approach, 9 Fr and 4 Fr sheaths were placed in the right and left femoral arteries, respectively. Through the 4 Fr sheath, a 4 Fr SY3 catheter

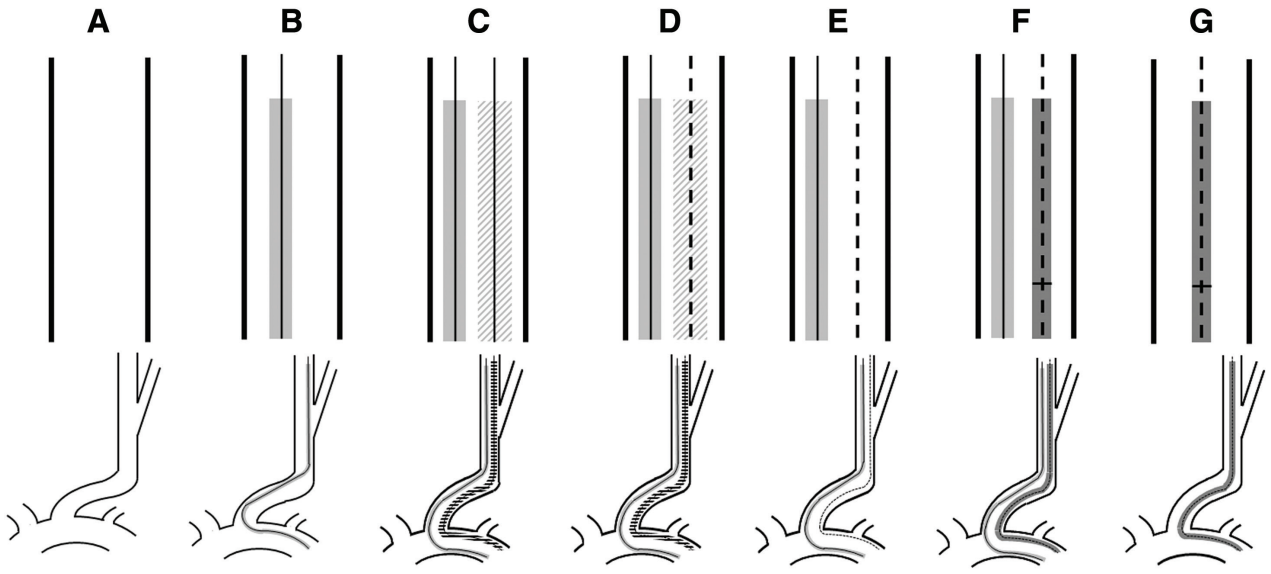

Fig. 2 Shamer of the buddy catheter technique. Upper row: Tips of the catheters and guidewires are placed in the ECA. Lower row: Shamer from the aortic arch to the carotid artery. (**A**) Before inserting the catheter. (**B**) A 4 Fr SY3 catheter and a half-stiff guidewire are placed in the left ECA. (**C**) A 6 Fr guiding catheter is inserted into the ECA. The left CCA is lifted upward. (**D**) Then, the guidewire in the 6 Fr guiding catheter is changed to an extra-stiff guidewire. (**E**) The 6 Fr guiding catheter is removed leaving the extra-stiff guidewire. (**F**) The Mo.Ma. Ultra is inserted. (**G**) The 4 Fr SY3 catheter and the half-stiff guidewire are removed. Gray curve: 4 Fr SY3 catheter, shaded curve: 6 Fr guiding catheter, dotted line: extra-stiff guidewire, and dark gray curve: Mo.Ma. Ultra. CCA: common carotid artery; ECA: external carotid artery

was inserted into the left ECA and a half-stiff guidewire was inserted into the 4 Fr SY3 catheter for additional support in the catheter. Then, through the 9 Fr sheath, a 118 cm 6 Fr guiding catheter and a 139 cm 4 Fr SIM2 angiographic catheter (Medikit, Tokyo, Japan) were inserted into the left ECA with some difficulty because of the steep angle of the left CCA and the tortuosity of the ECA. An extra-stiff guidewire was inserted into the 6 Fr guiding catheter. We had difficulty inserting an extra-stiff guidewire into the distal portion of the ECA; the tip of the guidewire reached the height of the facial artery bifurcation of the ECA. The left CCA was displaced upward, and the route from the descending aorta to the left CCA was straightened by the extra-stiff guidewire within the catheter. The 6 Fr guiding catheter was exchanged with the Mo.Ma Ultra, which was inserted into the left ECA without any obstruction afterward (**Fig. 1C–1E**). After the insertion of the Mo.Ma Ultra, the buddy catheter was removed, and a Casper-RX stent (MicroVention Terumo, Aliso Viejo, CA, USA) was deployed without any trouble (**Fig. 2**).

Discussion

The Mo.Ma Ultra alleviates blood stagnation in the carotid artery without crossing the stenotic lesion, and its efficacy and safety were described in the ARMOUR pivotal trial. In a few previous reports, the Mo.Ma Ultra was more effective in reducing microembolic signals during the procedure than were filter devices.[5,6] However, some technical problems may arise because of the complexity of the procedure or during the exchange of the catheter with the Mo.Ma Ultra. Patients who undergo CAS tend to have tortuous vessels as a result of atherosclerosis. In cases of left ICS in which the CCA branches off the aortic arch at a steep angle, insertion of the Mo.Ma Ultra into the CCA is sometimes difficult. The Mo.Ma Ultra often stops at the origin of the left CCA or slips down into the aortic arch. There are two possible causes. 1) At the location of the working channel, the Mo.Ma Ultra is easier to bend than in the surrounding area, even if the inner mandrel and super-stiff wire are inserted. Once the working channel was at the origin of CCA, the bending phenomenon may have caused the device to slide down. This bending phenomenon was also observed in an in vitro experiment (**Fig. 3**). 2) The working channel of the Mo.Ma Ultra was stuck at the edge of the CCA because of the ledge effect, which hindered the insertion of the device into the carotid artery.

Our buddy catheter technique is based on the use of a buddy wire to insert the Mo.Ma Ultra smoothly into the left CCA, in which an additional catheter is inserted into the left CCA to further straighten the access route. The buddy wire technique (sheep technique) is often used in gastrointestinal endoscopy or in the treatment of coronary artery disease to guide catheters through tortuous or calcified

Fig. 3 (**A**) The Mo.Ma Ultra is forced to bend. Circle: Despite the presence of an extra-stiff wire, the working channel of the Mo.Ma Ultra is the location that is the easiest to bend. (**B**) A 9 Fr guiding balloon catheter is forced to bend with a 4–6 Fr catheter and a guide wire is inserted. The catheter formed a round curve compared to the Mo.Ma Ultra.

lesions.[7,8] The buddy wire facilitates catheter insertion by anatomically straightening the vessels, and the ledge effect can be prevented by straightening the vessels with the wire. This effect has also been demonstrated in neuroendovascular treatment, such as intracranial stenting, flow diverter stenting, or catheterization of a tortuous subclavian artery.[9–11] Because it is technically difficult to insert only a guidewire into ECA in neuroendovascular procedures and because we could not use more than one guidewire with the Mo.Ma Ultra, we decided to insert another catheter with a guidewire into ECA, assuming that the support of the access route would be stronger than when only one additional wire was used. In our case, by placing a catheter with a half-stiff guidewire and an extra-stiff wire, the left CCA was stretched, and the Mo.Ma Ultra was inserted smoothly into the ECA.

Additionally, when the super-stiff wire is inserted into a catheter in the ECA, the catheter sometimes moves or, in the worst case, slips off the wire, especially when the wire passes through the aortic arch. In our buddy catheter technique, insertion of an additional catheter with a wire may prevent these problems by straightening the access route.

A limitation of the buddy catheter technique, however, is that it requires bilateral femoral puncture, which may increase the risk of hemorrhage at the puncture site in patients receiving multiple antiplatelet drugs for conditions such as subcutaneous hematoma or pseudoaneurysm. Moreover, in this technique, multiple devices are inserted into a single vessel, which can increase the risk for a thrombotic complication; thus, strict systemic heparinization during the procedure is mandatory.

Conclusion

Our buddy catheter technique facilitates the insertion of the Mo.Ma Ultra into a left CCA that branches off the aortic arch at a steep angle by displacing the left CCA upward. This technique can be performed independently and should be considered in such cases.

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Disclosure Statement

The authors declare that they have no conflicts of interest.

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