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Technical Note

Stenting for Common Carotid Artery Stenosis Using the Sheath Pull-Through Technique

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Objective: We report the "sheath pull-through technique" for stenting of common carotid artery stenosis (CCAS).
Case Presentations: In this technique, an 8–10 Fr super-long sheath (SLS) 55–65 cm is inserted into the femoral artery and the brachiofemoral pull-through technique is subsequently used, improving the support of the sheath itself. We pulled both ends of a pull-through wire to further improve the support of SLS, stabilizing guiding catheter (GC) during the procedure in two cases.
Conclusion: This technique stabilizes GC during CCAS stenting.

Keywords ▶ common carotid artery stenosis, stenting, pull-through technique, super long sheath

Introduction

Among the types of carotid artery stenosis, common carotid artery stenosis (CCAS) is rare. Regarding its incidence in patients with stroke, one study reported that there was no severe CCAS, whereas the incidence of internal carotid artery stenosis (ICAS) was approximately 30%.[1)] However, CCAS may cause cerebral infarction or ocular ischemic syndrome. In such cases, treatment is necessary.[2)] Stenting for CCAS is technically more difficult than that for ICAS. As the reason for this, it is difficult to secure the supportability of a guiding catheter (GC). Several previous studies attempted to secure GC supportability.[3)]

We devised the sheath pull-through technique to secure GC supportability. Initially, a 4 Fr sheath was inserted into the right brachial artery (BA). Subsequently, an 8–10 Fr super-long sheath (SLS) 55–65 cm was inserted into the femoral artery (FA). A wire inserted into the SLS was pulled through the 4 Fr sheath placed in the right BA (pull-through technique) (**Fig. 1A**). The SLS was guided immediately below a target blood vessel, and the two ends of the pull-through wire were pulled to improve SLS supportability. In 1 patient with stenosis at the origin of the left CCA, an SLS was used as a GC, and a wire was inserted into the SLS non-coaxially with a pull-through wire for treatment (**Fig. 1B–1E**). In 1 patient with right CCAS, a GC was inserted into an SLS non-coaxially with a pull-through wire, and guided/inserted into the proximal right CCA for treatment (**Fig. 1F–1I**). The respective cases are presented.

Case Presentations

Case 1: A 72-year-old man

Chief complaints

The main complaints were low vision of the left eye and progression of left CCAS.

Present illness

During the 2-year course, the progression of stenosis at the left CCA origin and low vision of the left eye were noted. Stenosis was progressive, suggesting CCAS-related ocular ischemic syndrome. Stenting was selected.

Physical examination on admission

His height was 157 cm. There was no neurological deficit other than low vision of the left eye. At the origin of the left

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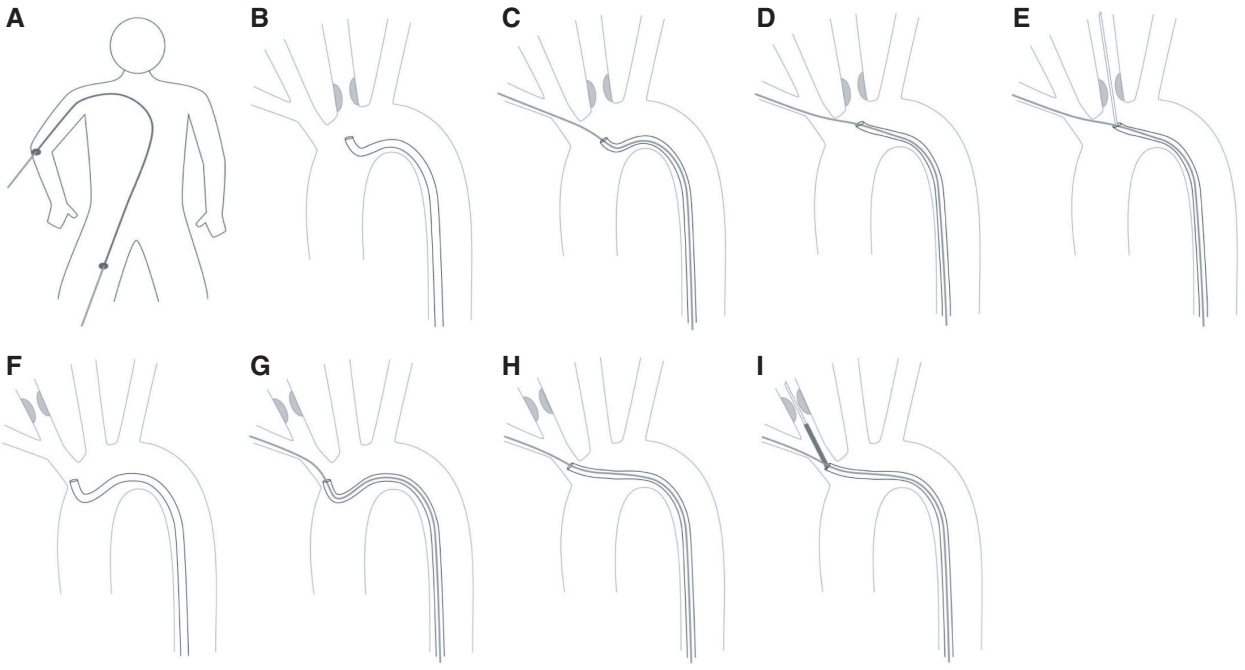

Fig. 1 Sheath pull-through technique. (**A**) Pull-through technique using the right BA and FA. (**B**–**E**) Scheme of the treatment system for stenosis at the left CCA origin. (**B**) An 8 Fr SLS 55 cm was inserted through the right FA and guided to the aortic arch. (**C**) A 0.025-inch GW was inserted into the SLS and pulled through a 4 Fr sheath placed in the right BA (pull-through technique). (**D**) When the two ends of the GW were pulled, the SLS tip was elevated, improving its supportability. (**E**) A therapeutic wire was inserted into the SLS non-coaxially with the GW. (**F**–**I**) Scheme of the treatment system for right CCAS. (**F**) A 10 Fr SLS of 65 cm was inserted through the right FA and guided to the aortic arch. (**G**) A 0.018-inch MGW was inserted into the SLS and pulled through a 4 Fr sheath placed in the right BA (pull-through technique). (**H**) When the two ends of the MGW were pulled, the SLS tip was elevated, improving its supportability. (**I**) A GC was inserted into the SLS non-coaxially with the MGW for treatment. BA: brachial artery; CCA: common carotid artery; FA: femoral artery; SLS: super-long sheath; GW: guidewire; MGW: microguidewire

CCA, 99% stenosis (the North American Symptomatic Carotid Endarterectomy Trial [NASCET]) was observed (**Fig. 2A**), and the aortic arch was evaluated as type 1.

Clinical course

Dual antiplatelet therapy (DAPT) was started 7 days before admission. After surgery, there were no symptomatic complications and the patient was discharged.

Endovascular treatment

A 4 Fr sheath was inserted into the right BA. An 8 Fr SLS 55 cm was inserted through the right FA. A 0.025-inch guidewire (GW) 260 cm was inserted into the SLS, captured using a 7-mm snare in the right subclavian artery, and pulled through the sheath placed in the right BA (pull-through technique) (**Fig. 2B**). The two ends of the pull-through wire were pulled and fixed with a Pean under tension to improve SLS supportability. The end of a 4 Fr Simmons-type catheter, which was guided non-coaxially with the pull-through wire, was hooked at the stenotic lesion site and passing the lesion was conducted using a 0.035-inch GW. A GuardWire was inserted into the 4 Fr catheter for distal CCA protection (**Fig. 2C**), and predilation was performed at the CCA origin (**Fig. 2D**). Subsequently, an expandable balloon stent was guided. The stenotic lesion was hard, making stent guiding difficult and inducing deflection of the stent shaft. A 0.014-inch microguidewire (MGW) of 200 cm was inserted into the left CCA non-coaxially with the GuardWire to improve SLS supportability. However, it was difficult to guide the stent; therefore, tension at the two ends of the pull-through wire was further increased to improve SLS supportability, facilitating stent guiding (**Fig. 2E–2I**). Aortic angiography was performed through a pigtail catheter inserted to the aortic arch to establish the position of the proximal stent edge. Final angiography confirmed favorable dilation at the left CCA origin (**Fig. 2J**).

Devices

An 8 Fr Brite Tip sheath 55 cm (Cordis, Hialeah, FL, USA), 0.025-inch radifocus GW angle 260 cm (Terumo, Tokyo, Japan), 0.014-inch MGW CHIKAI 200 cm (Asahi Intecc, Aichi, Japan), 7 mm snare (Goose-Neck Snare SK 700; Microvena, White Bear Lake, MN, USA),

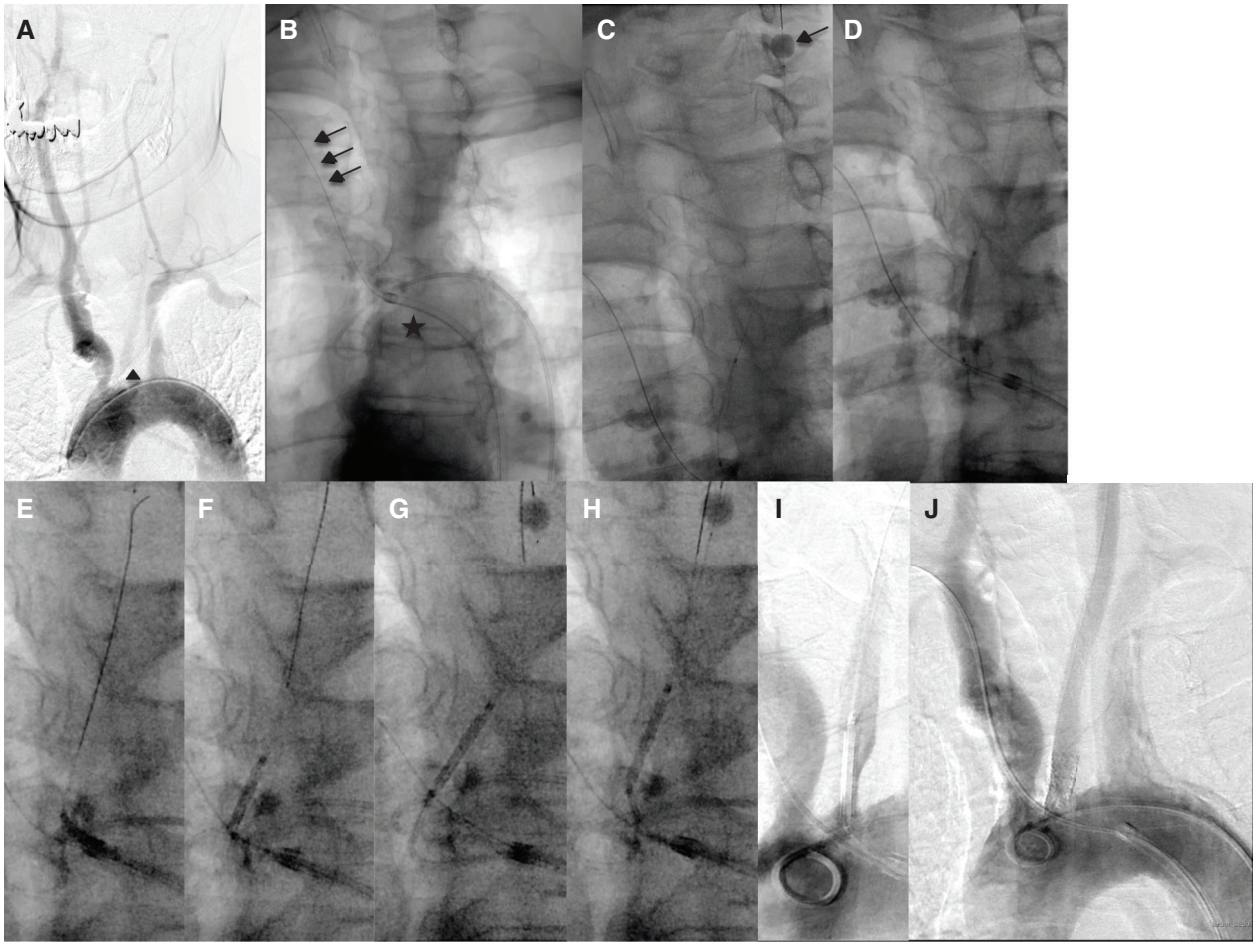

Fig. 2 Case 1: Stenosis at the left CCA origin. (**A**) Stenosis (arrow head) was observed at the left CCA origin. (**B**) The tip of an 8 Fr SLS 55 cm (asterisk) was placed in the aortic arch. A 0.025-inch GW (arrow) was inserted into the SLS and pulled through a 4 Fr sheath placed in the right BA (pull-through technique). (**C**) A GuardWire (arrow) was inserted into the SLS non-coaxially with the GW in the SLS and placed in the distal CCA for distal protection. (**D**) Predilation was conducted using a PTA balloon. (**E–I**) On guiding a stent beyond the site of stenosis, deflection of the stent shaft made guiding difficult. Tension at the two ends of the pull-through wire was increased to improve SLS supportability, facilitating stent guiding. (**J**) After stenting, favorable dilation of the left CCA was achieved. BA: brachial artery; CCA: common carotid artery; GW: guidewire; PTA: percutaneous transluminal angioplasty; SLS: super-long sheath

GuardWire (Medtronic, Santa Rosa, CA, USA), Sterling percutaneous transluminal angioplasty (PTA) balloon 3.5 × 30 mm (Boston Scientific, Marlborough, MA, USA), and Express LD 8 × 17 mm (Boston Scientific) were used.

Case 2: An 82-year-old woman

Chief complaints

None.

Present illness

Brain magnetic resonance imaging (MRI) revealed old cortical infarction in the right hemisphere. As right CCAS was considered to be the source of embolism, stenting was selected.

Physical examination on admission

Her height was 143 cm. There was no neurological deficit, but 90% (NASCET) stenosis of the right CCA was observed (**Fig. 3A**). The aortic arch was evaluated as type 2.

Clinical course

DAPT was started 7 days before admission. After surgery, there were no symptomatic complications, and the patient was discharged.

Endovascular treatment

A 4 Fr sheath was inserted into the right BA. A 10 Fr SLS 65 cm was inserted through the right FA. A 0.018-inch MGW 300 cm was inserted into the SLS to prepare a pull-through wire, as described for Case 1 (**Fig. 3B**). The two ends of the

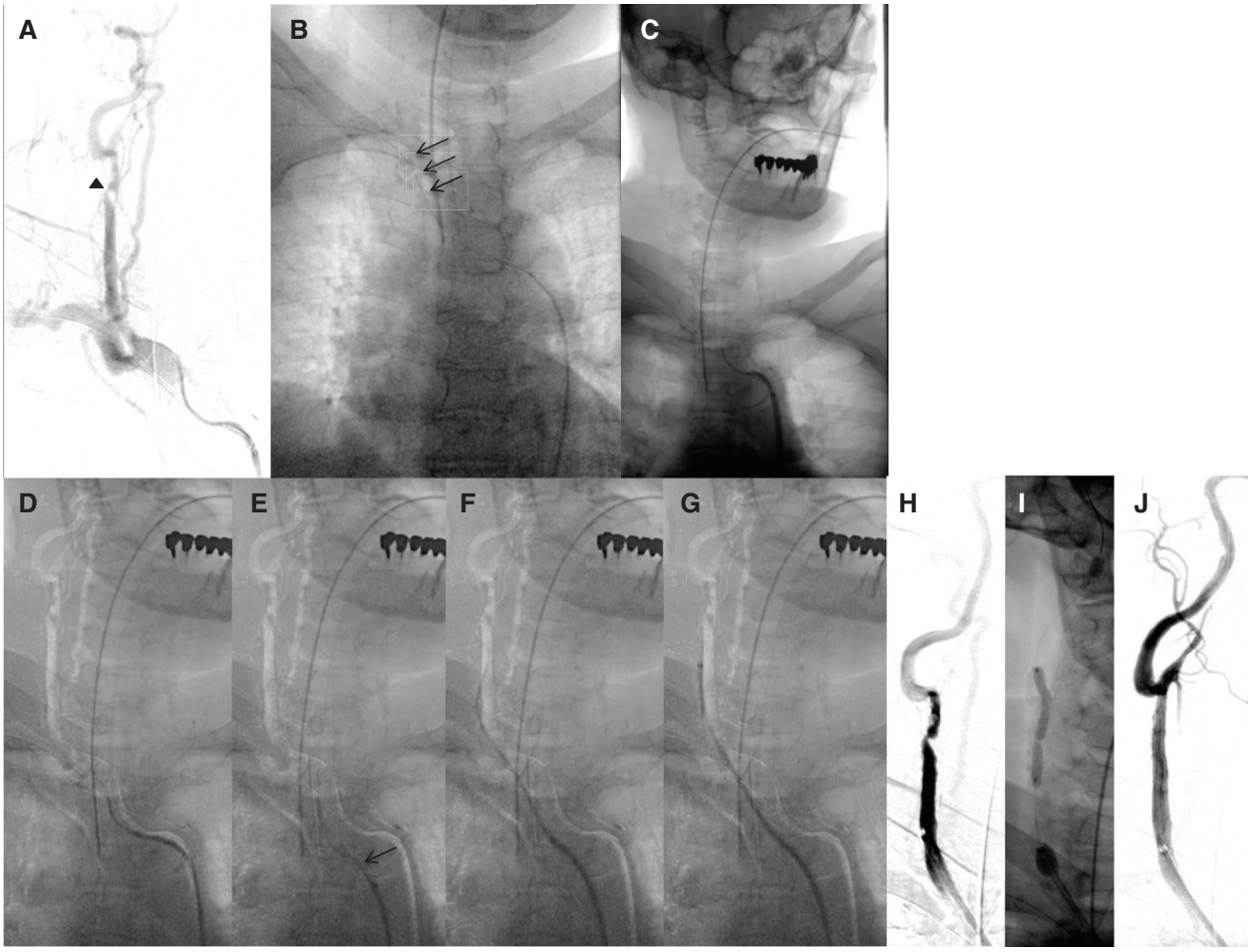

Fig. 3 Case 2: Right CCA stenosis. (**A**) Stenosis of the right CCA (arrow head) was observed. (**B**) The tip of a 10 Fr SLS 65 cm was guided to the aortic arch. A 0.018-inch MGW was inserted into the SLS and pulled through a 4 Fr sheath placed in the right BA (pull-through technique) (arrow). (**C**) An 8 Fr BGC coaxial system was inserted into the SLS non-coaxially with the MGW and guided into the right CCA. (**D**) A state in which the two ends of the pull-through wire were not pulled. (**E**–**G**) A state in which the two ends of the pull-through wire were pulled. The entire system became linear (arrow). It was possible to guide a BGC such that the 0.035-inch GW did not migrate beyond the lesion. (**H**) Stenosis of the right CCA was observed. (**I**) After inflating a BGC balloon, flow reversal was arranged and predilation with a PTA balloon was conducted. (**J**) After stenting, favorable dilation of the right CCA was achieved. BA: brachial artery; BGC: balloon guiding catheter; CCA: common carotid artery; FA: femoral artery; GW: guidewire; MGW: microguidewire; PTA: percutaneous transluminal angioplasty; SLS: super-long sheath

pull-through wire were pulled, and tension was added. The entire system became linear (**Fig. 3E**). When inserting an 8 Fr Balloon GC into the right CCA using a coaxial system non-coaxially with the pull-through wire, a 0.035-inch GW was able to be guided such that it did not migrate beyond the stenotic lesion (**Fig. 3C–3G**). For distal protection, a GuardWire was inserted into the distal internal carotid artery, and predilation/stenting was performed at the site of stenosis under flow reversal state (**Fig. 3I**). On passing the stenotic lesion with the therapeutic device, the GC made a slipping-like motion down to the aorta, but tension at the two ends of the pull-through wire was enhanced to improve SLS supportability. The GC did not slip down to the aorta, facilitating passing the lesion with the device. Treatment was accomplished. The final angiography confirmed favorable dilation (**Fig. 3J**).

Devices

A 10 Fr catheter introducer 65 cm (Medikit, Tokyo, Japan), 0.018-inch Treasure Floppy 300 cm (Asahi Intecc), 7 mm snare, 8 Fr Optimo 90 cm (Tokai Medical Products, Aichi, Japan), 4–6 Fr JB2 130 cm, GuardWire, Sterling PTA balloon 4 × 40 mm, Protégé 8 × 60 mm (Medtronic), and Sterling PTA Balloon 4.5 × 20 mm were used.

Discussion

For the treatment of CCAS, it is impossible to guide a 0.035-inch GW into the external carotid artery (ECA) without touching the site of stenosis, differing from the treatment of ICAS. Therefore, GC guidance is difficult and strategies to stabilize it are required in many cases. Previous

studies reported a method to insert a Goose Neck Snare through the BA and capture/stabilize a GC inserted through the FA[4]; a method to insert a GuardWire and/or a GW for support into the ICA and ECA, respectively, for GC stabilization[5]; and a method to insert a Simmons-type guiding sheath through the radial artery.[6] As a method using the pull-through technique, as introduced in this report, a method to prepare a pull-through wire using the superficial temporal artery for GC stabilization[7] was presented.

The pull-through technique was first reported in 1988 as a technique for endovascular treatment of iliac artery occlusion.[8,9] For the treatment of subclavian or vertebral artery lesions, brachiofemoral approach[10] and bilateral brachial approach[11] have been reported. These studies demonstrated that when subclavian or brachiocephalic artery stenosis was present at the origin of a branch from the aorta, GC-pull-through operations for stabilizing a GC placed in the aorta were effective. We devised our method "sheath pull-through technique" in reference to this.

We devised pulling through a 55–65 cm SLS in order to prepare a high-supportability base. In this method, the SLS itself can also be used as a GC. Furthermore, it is possible to insert a GC into the SLS non-coaxially with a pull-through wire for treatment. When inserting an 8 Fr GC into an SLS, a 10 Fr SLS is required, making the increase in sheath size a limitation. However, this method facilitated safe treatment for CCAS. Strong supportability was achieved by pulling through an SLS. Even when a markedly stenotic lesion was hard, the procedure was able to be performed in the absence of the GC slipping down to the aorta during treatment.

Conditions for adopting this method include a vascular diameter into which a 10 Fr sheath can be inserted through the FA, a state in which a sheath can be inserted to the right upper limb, the absence of stenosis or occlusion of blood vessels between the BA to the aorta, and the SLS tip reaching the inguinal puncture site to aortic arch (entire length of an access route, presence of tortuousness/stenosis). If a shaggy aorta is observed on preoperative assessment, injury of the aortic arch or blue toe syndrome related to such injury should be considered.

In patients meeting the above conditions, this method may be considered as an option to improve GC supportability.

Conclusion

For stenting for CCAS, a method to secure GC supportability using the sheath pull-through technique is effective.

Disclosure Statement

The main author completed self-reporting of conflict of interest to the Japanese Society for Neuroendovascular Therapy, and there is no conflict of interest to be disclosed with respect to the publication of this article. The other coauthors declare no conflicts of interest.

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