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Case Report

Transfemoral subclavian artery stenting through a shaped guiding catheter without pull-through technique: A case report☆

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ABSTRACT

Transfemoral subclavian artery stenting can be challenging unless the placement of the guiding catheter is secured. Herein, we present a patient with subclavian artery stenosis treated with endovascular stenting using a shaped guiding catheter. A 79-year-old woman was admitted to our department because of a cold sensation and numbness of her left arm. Computed tomography revealed stenosis of the left subclavian artery (SA), located just proximal to the ostium of the left vertebral artery (VA). Doppler ultrasound showed reverse flow in the left VA. We planned to stent for the SA stenosis under the balloon protection of the left VA. The balloon protection device was easily navigated into the left VA through brachial access. After that, a self-expandable stent was successfully placed from just proximal to the VA origin to the ostium of the SA using a highly stable shaped guiding catheter. The patient recovered from the symptoms and was discharged 4 days after the procedure. The high stability of the shaped guiding catheter is advantageous during endovascular treatment of the subclavian artery.

Introduction

Stable positioning of the guiding catheter is necessary in transfemoral endovascular angioplasty or stenting for stenoocclusive lesions of the subclavian artery (SA). However, maintaining the straight-tip guiding catheters in a stable position is often difficult because of the short landing area of the guiding catheter and acute angulation of the aortic arch. In this situation, the pull-through technique has been used to sta-

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bilize the guiding catheter at the proximal segment of the SA [1,2]. However, because a guidewire should be passed from one site to another by grabbing it with a snare device in the usual pull-through technique, the procedure is time-consuming and complicated [3]. Herein, we present a patient with subclavian artery (SA) stenosis successfully treated with transfemoral endovascular stenting through a shaped guiding catheter without using the pull-through technique.

Case presentation

A 79-year-old woman with a history of scleroderma and multiple colorectal polyps was admitted to our department with a cold sensation and numbness in her left arm. Physical examination revealed weak pulsation in the left brachial and radial arteries. The blood pressure gradient in the upper limbs was 60 mmHg. CTA revealed stenosis of the left subclavian artery (SA), just proximal to the ostium of the left vertebral artery (VA) and stenosis of the left VA origin (Fig. 1A). Doppler ultrasonography demonstrated reverse flow in the left VA (Fig. 1B). The patient was scheduled to undergo stenting for the SA stenosis. To address the occlusion of the left VA origin by the snow-plow effect after stenting and thrombus migration during the procedure, angioplasty and stenting for the SA stenosis were planned to be performed under balloon protection of the VA origin. The patient received aspirin (100 mg) and clopidogrel (75 mg) 7 days before the intervention. Under local anesthesia, a 4-French (Fr) FUBUKI neurovascular dilator guiding kit (Asahi Intec Co., Ltd., Aichi, Japan) was inserted into the distal segment of the SA through the left brachial artery access for balloon placement in the left VA. An 8-Fr guiding catheter (IWATE guiding catheter, 83 cm; Medikit, Tokyo, Japan) was used for stent deployment. The 8-Fr IWATE guiding catheter is shaped like a JB2 diagnostic catheter with a stiff shaft and can be navigated into the aortic arch via both the guidewire and the 6-Fr inner catheter. The wire and inner catheter are withdrawn to expose the angle of the guiding catheter. The guiding catheter was then pulled back slowly and directly placed in the subclavian artery without touching the stenotic lesion with the catheter tip (Fig. 1C). Heparin was administered to achieve an activated clotting time $>$ 250 s. Then, a CHIKAI 14 200-cm microguidewire (Asahi Intech Co., Ltd, Aichi, Japan) and a non-compliant balloon (Coyote 3 $\times$ 40, Boston Scientific) were navigated into the left VA through the left brachial access. Subsequently, another CHIKAI 14 200-cm microguidewire was navigated further into the left radial artery through the 8Fr-IWATE guiding catheter to achieve a better anchoring effect. Under the protection of the VA, the PTA balloon (Rx Genity 6 $\times$ 40, KANEKA) was navigated over the wire from the femoral access and inflated at nominal pressure for 1 min covering the stenotic lesion (Fig. 1D). Concerning the balloon is stuck by being jailed in the stent, we attempted to deploy the stent, Precise 7 $\times$ 30 (Cordis Corporation, NJ, USA), just proximal to the ostium of the VA. Although the guiding catheter was placed in the SA with a relatively short landing, the high stability of the guiding catheter allowed intentional stent placement from just proximal to the VA origin to the proximal SA and re-cannulation of the guiding catheter into the stent (Fig. 1E). After deflation of the balloon in the left VA, a subclavian arteriogram showed sufficient dilatation of the SA and antegrade flow in the left VA (Fig. 1F). Post-dilatation was not performed because of acceptable stent expansion. The patient's symptoms resolved and she was discharged 4 days after the procedure. The step-by-step procedure is shown in the Supplementary Video (Video 1).

Discussion

This case demonstrated a useful technique for transfemoral angioplasty/stenting using a shaped guiding catheter without a pull-through technique. Transfemoral stenting using a JB2-shaped and stiff-tip guiding catheter has several advantages. First, the JB2 shape of the IWATE guiding catheter allowed direct catheterization of the left SA. Second, the stiffness of the catheter can maintain a stable positioning of the tip of the guiding catheter in the SA during angioplasty and stenting. Third, the transfemoral procedure can be performed without the pull-through technique.

In cases of atheromatous in the SA located proximal to the ipsilateral VA, cerebral protection is required during angioplasty/stenting. This case carried a risk of plaque shifting into the vertebral artery during the procedure due to the proximity of the stenotic lesion to the origin of the left VA. Therefore, the affected VA should be protected during the procedure. The stent should traverse the stenotic area of the SA without covering the VA origin, which requires accurate stent deployment. In this scenario, the guiding catheter needed to be highly stable. A shaped guiding catheter was helpful in the present case.

Stenting for SA with vertebral artery protection has been performed via either an antegrade or a retrograde approach. The pull-through technique has been used for stable stent deployment [1,4,5]. However, this complicated procedure may carry the risk of endothelial damage or even arterial tearing caused by the wire being pulled from 2 different access sites. Stenting using a guiding catheter without the pull-through technique was possible in a less invasive manner in the catheterized artery. When performing retrograde stenting for SA lesions, high stability of the guiding catheter is achieved under cerebral protection. However, in the case of an SA atherosclerotic lesion proximal to the VA, cerebral protection can be achieved by occlusion of the VA with a catheterized balloon or balloon guiding catheter [6,7]. Stenting under VA protection with the cannulated balloon could have been possible if the large-bore sheath could be placed in the left brachial access. However, this was not attempted in the present case, concerning that the balloon in the left VA may be stuck by being jailed the stent. When a balloon guiding catheter is used to protect the VA, stent deployment just proximal to the VA origin would be challenging due to proximity to the fixed balloon guiding catheter protecting the VA origin.

Most mono-rail self-expandable stents are compatible with guiding catheters with an inner diameter of 6-Fr or above. Several types of guiding catheters with 6-Fr inner diameters are available in Japan, such as the JB2 and Simmons shapes. The JB2 shape-guiding catheters included 8-Fr IWATE, 83 cm (Medikit, Japan) (Fig. 2A), 8-Fr SEL-E, 83 cm (Medikit, Japan)

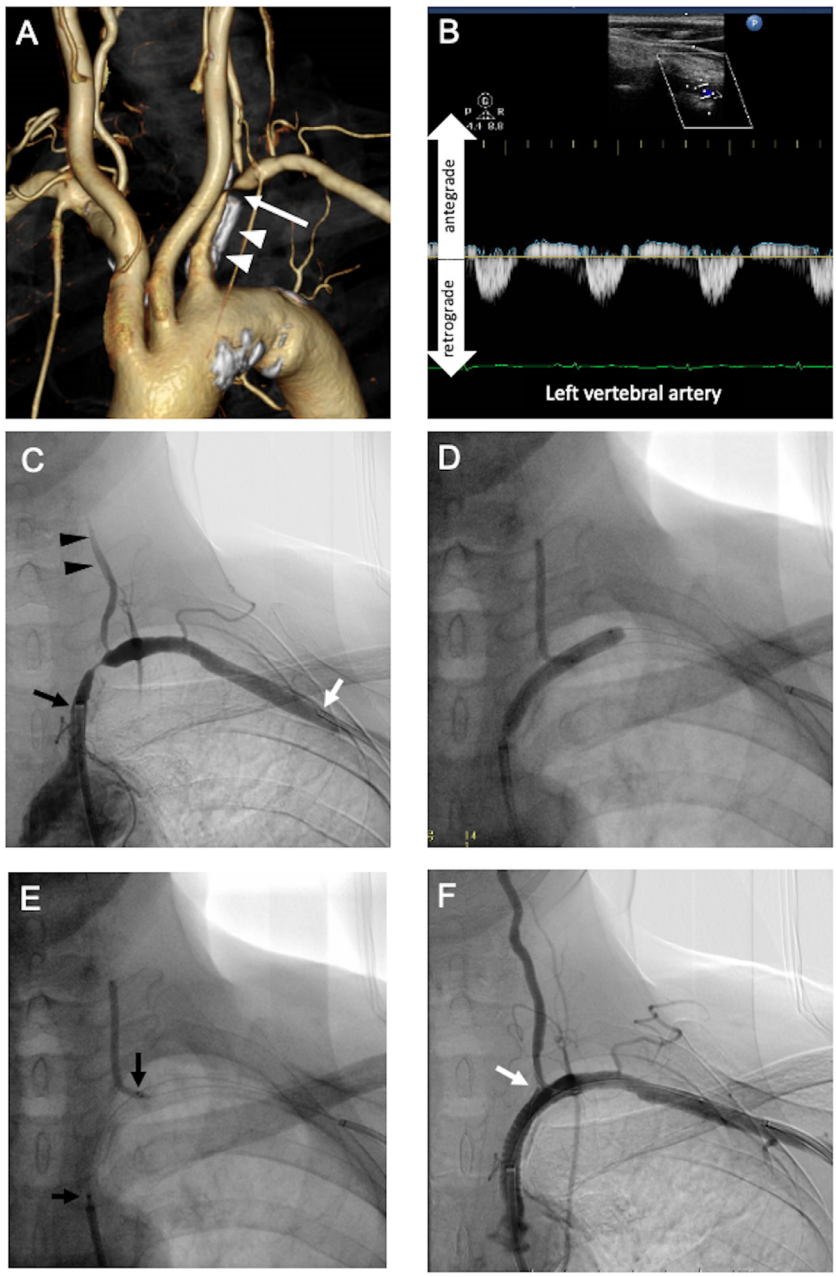

Fig. 1 – (A) Anteroposterior view of computed tomography angiogram shows a stenotic lesion of the left subclavian artery (white arrow) with calcification (white arrowheads). (B) Doppler ultrasonography of the left vertebral artery obtained preoperatively shows retrograde blood flow. (C) Before the procedure, the left subclavian artery injection reveals a stenotic lesion just proximal to the origin of the left vertebral artery and stagnant flow in the vertebral artery (black arrowheads). Black and white arrows indicate an 8-French (Fr) shaped guiding catheter and 4-Fr dilator sheath, respectively. (D) Angioplasty for the subclavian artery stenosis under the protection of the vertebral artery with a balloon. (E) Stent deployment without covering the origin of the vertebral artery. Black arrows indicate distal and proximal markers before deploying the stent. (F) After the procedure, the left subclavian artery injection shows a successful dilatation of the subclavian artery and antegrade flow in the left vertebral artery. Note that the distal flare of the stent was located just proximal to the origin of the left vertebral artery (white arrow).

(Fig. 2B), and 8-Fr NeuroEBU, 90 cm (Hanako Medical, Japan) (Fig. 2C). As previously described, shape-guiding catheters have been used to support the navigation of intermediate or inner catheters into targets [8,9]. In contrast, the present case represents the utility of the single use of a shaped guiding catheter, the 8-Fr IWATE. The main feature of this guiding catheter is a stiff JB2 shape with a long tip. Therefore, the tip can be steadily anchored to the supra-aortic vessel and allows

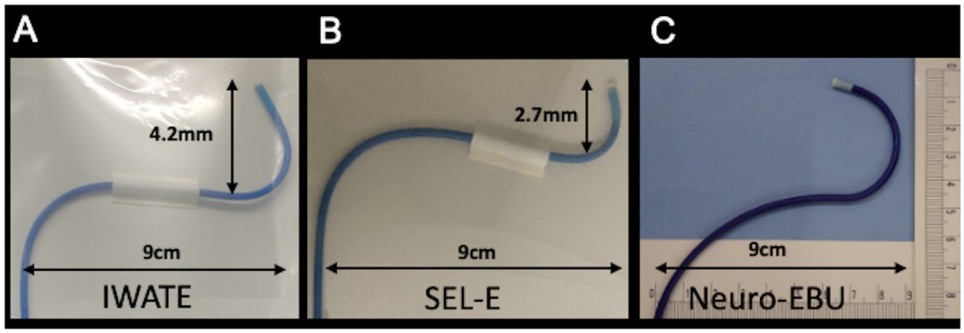

Fig. 2 – Different types of 8-Fr shaped guiding catheters are available in Japan. They differ in the tip shape and length. (A) Iwate guiding catheter (Medikit, Japan) is a JB2 shape with a total length of 83 cm and an inner diameter of 0.088 inches. (B) SEL-E guiding catheter (Medikit, Japan) has the same total length and inner diameter as Iwate, but its tip length is 1.5 cm shorter than Iwate. (C) Neuro-EBU (Hanako Medical, Japan) has a J shape tip with a full length of 83 cm and an inner diameter of 0.090 inches.

angioplasty and stenting without the pull-through technique. Since the short tip of SEL-E or the long tip of NeuroEBU might have offered similar support to the IWATE guiding catheter, we can select appropriate shaped guiding catheter depending on whether the length and axis of the shaped catheter are appropriate for the target vessel. Simmons type guiding catheters, 6-Fr MSK guide sheath, 90 cm (Medikit, Japan) with a distal tip of 5.0 cm or 7.5 cm, and 6-Fr Axcelguide STIFF-J-1 and J-2, 90 cm (Medikit, Japan) with a distal tip of 8.0 cm and 11.0 cm, are also available [10,11]. Although Simmons guiding catheters were initially designed for the transradial or transbrachial approach, the longer tip might be useful for angioplasty/stenting of relatively distal supra-aortic lesions.

As a limitation, stiff-type guiding catheters could cause plaque embolism due to scraping of pathological vessels [12,13], guiding catheters should be chosen depending on the angle and length of the target lesion from the aorta.

We describe a new application of a shaped guiding catheter. A single use of an 8-Fr IWATE guiding catheter is an alternative option to achieve stable positioning of a guiding catheter when performing angioplasty or stenting for the supra-aortic vessel.

Human rights statements and informed consent

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and later versions. Informed consent was obtained from the patient for publication of this case report and any accompanying images.

Patient consent

Informed consent was obtained from the patient for the publication of this case report.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.radcr.2022.07.013.

REFERENCES

[1] Mordasini P, Gralla J, Do DD, Schmidli J, Keserü B, Arnold M, et al. Percutaneous and open retrograde endovascular stenting of symptomatic high-grade innominate artery stenosis: technique and follow-up. AJNR Am J Neuroradiol 2011;32:1726–31. doi:10.3174/ajnr.A2598.

[2] Matsumoto Y, Nakai K, Tsutsumi M, Iko M, Oishi H, Eto H, et al. A simplified pull-through angioplasty technique without a snare device. a technical note. Interv Neuroradiol 2013;19:167–72. doi:10.1177/159101991301900204.

[3] Nazarian GK, Myers TV, Bjarnason H, Stackhouse DJ, Dietz CA, Hunter DW. Applications of the Amplatz snare device during interventional radiologic procedures. AJR Am J Roentgenol 1995;165:673–8. doi:10.2214/ajr.165.3.7645494.

[4] Kusaka N, Tamiya T, Nishiguchi M, Takayama K, Nishiura T. Bilateral brachial pull-through technique for stenting in a patient with stenosis of the vertebral artery origin: technical case report. Neuroradiology 2007;49:837–9. doi:10.1007/s00234-007-0256-7.

[5] Saito T, Takeuchi M, Suzuki K, Nishiyama Y, Okubo S, Kimura K. Stenting for common carotid artery stenosis using the sheath pull-through technique. J Neuroendovasc Ther 2021;15:129–33.

[6] Fakih R, Dandapat S, Mendez-Ruiz A, Mendez AA, Farooqui M, Zevallos C, et al. Combined transradial and transfemoral approach with ostial vertebral balloon protection for the treatment of patients with subclavian

steal syndrome. Front Neurol 2020;11:576383. doi:10.3389/fneur.2020.576383.
[7] Yamamoto T, Ohshima T, Ishikawa K, Goto S, Tamari Y. Feasibility and safety of distal and proximal combined endovascular approach with a balloon-guiding catheter for subclavian artery total occlusion. World Neurosurg 2017;100:709.e5–709.e9. doi:10.1016/j.wneu.2017.02.018.
[8] Himeno T, Ota S, Ohtonari T, Kanbara M, Takeuchi M, Nomura E, et al. Efficacy of the insertion-support guiding catheter in approaching intracranial or craniocervical lesions in patients with the difficulty of extracranial trans-arterial access. J Neuroendovasc Ther 2020;14:36–42.
[9] Mizowaki T, Fujita A, Imura J, Nakahara M, Tanaka H, Takaishi Y, et al. Ostial common carotid artery occlusion and balloon-mounted stenting: Implication of embolic protection device in tandem lesion. Radiol Case Rep 2021;16:2783–6. doi:10.1016/j.radcr.2021.06.071.
[10] Hanaoka Y, Koyama JI, Ogiwara T, Miyaoka Y, Fujii Y, Nakamura T, et al. Usefulness of a novel technique to make up for a deficiency in transradial neurointervention with a 6Fr simmonds guiding sheath: original experience with the subclavian artery anchoring technique. World Neurosurg 2019;131:e362–70. doi:10.1016/j.wneu.2019.07.162.
[11] Ito H, Uchida M, Takasuna H, Goto T, Takumi I, Fukano T, et al. Left transradial neurointerventions using the 6-French Simmons guiding sheath: initial experiences with the interchange technique. World Neurosurg 2021;152:e344–51. doi:10.1016/j.wneu.2021.05.110.
[12] Ito H, Uchida M, Sase T, Kushiro Y, Wakui D, Onodera H, et al. Risk factors of contralateral microembolic infarctions related to carotid artery stenting. Neurol Med Chir (Tokyo) 2018;58:311–19. doi:10.2176/nmc.oa.2018-0023.
[13] Ito H, Uchida M, Kaji T, Go Y, Hidaka G, Takasuna H, et al. Risk factors of cerebellar microembolic infarctions after carotid artery stenting. World Neurosurg 2020;142:e290–6. doi:10.1016/j.wneu.2020.06.207.