

Stent insertion for chronic total occlusion of the common carotid artery in a patient with Takayasu arteritis using an adjunctive retrograde approach via superficial temporal artery puncture: illustrative case

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BACKGROUND Takayasu arteritis is a large-vessel vasculitis characterized by chronic inflammatory lesions that frequently lead to stenosis and occlusion of the common carotid artery (CCA). Endovascular revascularization for these inflammatory lesions is particularly challenging because the fibrotic and calcified vessel walls frequently hinder the passage of wires and catheters from a conventional antegrade approach.

OBSERVATIONS The authors report the case of a 57-year-old female with Takayasu arteritis who presented with a chronic total occlusion of the right CCA. The initial antegrade endovascular attempt resulted in wire dissection, necessitating an alternative strategy. They successfully performed retrograde recanalization via surgical cutdown of the superficial temporal artery (STA). A pull-through technique was utilized to establish a wire rail, which enabled safe and effective placement of the stent across the occluded segment. The patient's postoperative course was uneventful.

LESSONS The present case illustrates that a retrograde approach from the STA is a viable and effective alternative strategy for treating challenging CCA occlusions in patients with Takayasu arteritis. This technique expands the therapeutic options for complex vascular lesions that might otherwise be considered untreatable using conventional methods.

<https://thejns.org/doi/abs/10.3171/CASE25897>

KEYWORDS Takayasu arteritis; retrograde approach; chronic total occlusion; superficial temporal artery; pull-through technique

Takayasu arteritis is an idiopathic large-vessel vasculitis that causes chronic granulomatous inflammation of the aorta and its major branches. Lesions primarily affect the aortic arch and its branches, and as inflammation progresses, the vessel walls thicken, fibrose, and lead to stenosis, occlusion, or aneurysm formation. In the early stages, patients present with nonspecific systemic symptoms such as fever, malaise, and weight loss; however, advanced cases are dominated by symptoms resulting from local blood flow impairment, such as cerebral ischemia and visual disturbances.^{1–4}

Among these, chronic total occlusion of the common carotid artery (CCA) is not uncommon but is a challenging condition to treat. Owing to severe thickening, hardening, and calcification of the arterial wall caused by inflammation, wires and catheters often fail to pass through the lesion during conventional endovascular treatment, and a significant number of cases remain refractory to recanalization. Surgical treatments such as bypass surgery have been reported to have higher periprocedural complications like postoperative bleeding and stroke

compared to endovascular treatment, thus highlighting the growing importance of less invasive endovascular revascularization.^{5,6}

Endovascular revascularization for Takayasu arteritis is more difficult because of the length of the lesion, heterogeneity of the wall structure, and activity of the inflammation. Established techniques or approaches for chronic total occlusion at the CCA origin are limited. The antegrade approach (femoral artery → brachiocephalic artery → CCA) may fail to advance beyond the lesion in cases of severe proximal occlusion, necessitating alternative methods.

In this case, we successfully performed endovascular recanalization for a long-lesion chronic total occlusion originating from the CCA in a patient with Takayasu arteritis, for whom an antegrade approach was difficult. We achieved this by puncturing the superficial temporal artery (STA) and advancing the wire and catheter in a retrograde manner from the distal side.

The STA is a terminal branch of the external carotid artery, which is superficial and easily accessible and can be used as an alternative

ABBREVIATIONS CCA=common carotid artery; ICA=internal carotid artery; MPR=multiplanar reconstruction; STA=superficial temporal artery.

INCLUDE WHEN CITING Published February 23, 2026; DOI: 10.3171/CASE25897.

SUBMITTED November 15, 2025. **ACCEPTED** December 19, 2025.

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access route when needed. We report this case as an example of minimally invasive revascularization using a novel technique.

Illustrative Case

A 57-year-old female was diagnosed with aortitis at age 17 years and was treated with steroids at another hospital until age 22, after which she did not receive any treatment. She had not received regular outpatient follow-up. She was brought to the emergency room with limb numbness and mild left hemiparesis. On initial examination, she had mild dysarthria and a Manual Muscle Test score of 4 in her right upper and lower limbs. MRI revealed occlusion of the right middle cerebral artery and new infarcts in the right caudate nucleus, basal ganglia, and cortex (Fig. 1A and B). Right brachiocephalic artery angiography performed to attempt recanalization revealed an occlusion originating from the right CCA (Fig. 1C and D). The approach was deemed difficult, and because her symptoms were mild, treatment was abandoned. Three days later, MR angiography (MRA) revealed spontaneous recanalization of the middle cerebral artery (Fig. 1F). Blood tests during her hospital stay showed an erythrocyte sedimentation rate of 65 mm/hr, antinuclear antibody of 1280 times, anti-SSARoE of >1200.0, anti-SSBlaE of 24.2, and rheumatoid factor of 67. Testing was negative for anti-Smith, anti-ribonucleoprotein, and anti-cardiolipin antibodies. Human leukocyte antigen typing was positive for B52 and B67. She was diagnosed with Takayasu arteritis and

started on oral prednisolone 35 mg/day, which was tapered by 2.5 mg every week to 20 mg and then by 1 mg/wk to 5 mg. No recurrence of inflammation was observed.

Two years after the initial cerebral infarction, she developed occlusion of the right middle cerebral artery with dysarthria and mild left upper limb paresis. MRA showed proximal middle cerebral artery occlusion, and the site showed a low signal on T2*. In a manner similar to the previous course, spontaneous recanalization was observed on MRI the next day. Based on the clinical course and imaging findings, the cause was considered to be a thrombotic embolism. The hemodynamics of the right internal carotid artery (ICA) were such that it was visualized via the right ascending pharyngeal artery and right external carotid artery, suggesting that a thrombus may have formed in the occluded, blind-ended CCA and embolized to the middle cerebral artery. During this course, she also experienced transient right facial droop and dysarthria, which were attributed to stenosis of the left CCA.

Surgical Strategy

Recanalization of the right CCA was considered necessary to prevent further emboli in the right ICA territory. Given the TIA symptoms, treatment for left CCA stenosis was also required.

The initial strategy was to attempt antegrade recanalization of the right CCA. In the event of an unsuccessful attempt, the plan was to address the left CCA stenosis first, followed by consideration of

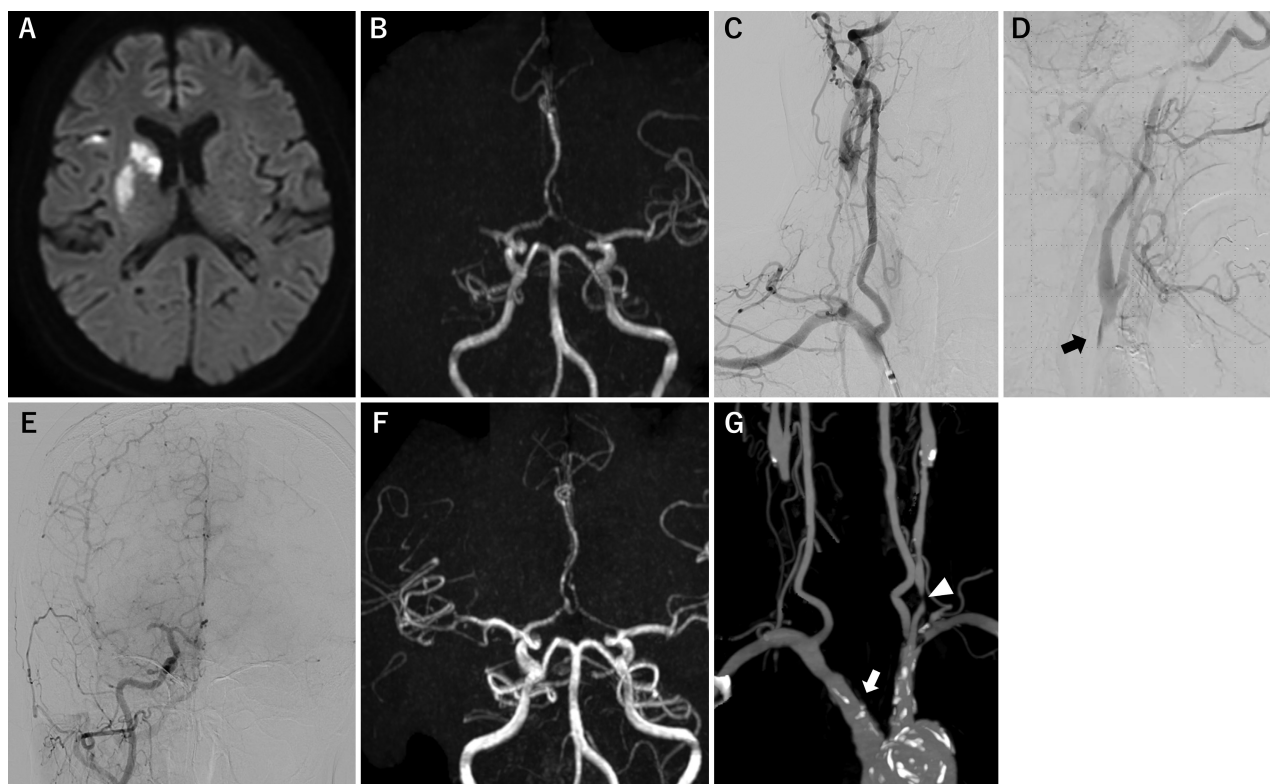


FIG. 1. Images obtained at the onset of right middle cerebral artery occlusion. **A:** MR diffusion-weighted image at onset. A high signal intensity was observed in the right caudate nucleus, basal ganglia, and cerebral cortex. **B:** MR angiogram at onset. Occlusion of the proximal right middle cerebral artery was observed. **C:** Right brachiocephalic artery angiogram showing occlusion from the origin of the right CCA. **D:** Right brachiocephalic artery angiogram (equilibrium phase). Contrast stagnation is observed at the blind end of the right CCA (arrow). **E:** Right brachiocephalic artery angiogram revealing occlusion of the right middle cerebral artery. **F:** MR angiogram obtained 3 days after onset, revealing recanalization of the right middle cerebral artery. **G:** Cervical CT angiogram showing occlusion of the right CCA (arrow) and severe stenosis of the left CCA (arrowhead).

retrograde recanalization of the right CCA. For right CCA recanalization, we planned to use balloon-guiding catheters in the brachiocephalic and subclavian arteries to block blood flow and prevent distal embolization via the CCA. We also aimed to utilize the subclavian steal phenomenon to ensure blood flow to the right ascending pharyngeal artery, right external carotid artery, and right ICA via the left vertebral artery to the right vertebral artery. Preoperative antiplatelet therapy consisting of 100 mg of aspirin and 75 mg of clopidogrel was administered 14 days before surgery.

An attempt was made to perform antegrade stent placement of the right CCA. The left CCA also underwent stent insertion.

A 9-Fr Optimo catheter (Tokai Medical Products) was guided from the right femoral artery to the brachiocephalic artery, and a 6-Fr Optimo catheter was guided from the right radial artery to the right subclavian artery. From the 9-Fr Optimo catheter, a RADIFOCUS guidewire (Terumo) or Guidepost (Tokai Medical Products) was used to select the right CCA (Fig. 2A), and an SL-10 microcatheter (Stryker Neurovascular) was advanced to the carotid bifurcation with a CHIKAI 14 guidewire (ASAHI INTECC) (Fig. 2B). Microangiography from the SL-10 microcatheter showed that the microcatheter had entered the false lumen. Further dissection was abandoned because it could lead to ICA occlusion.

A 9-Fr Optimo catheter was then guided to the left CCA origin (Fig. 2C), and an SL-10 microcatheter and CHIKAI 14 guidewire were advanced to the left ICA. The narrowest part was dilated with a SHIDEN 4 × 40-mm balloon (Kaneka Medix), and a SpiderFX device (Medtronic) was deployed in the left ICA to prevent distal thrombus embolization. Angiography confirmed extensive dissection from the common to external carotid artery (Fig. 2D). A Carotid WALLSTENT (Boston Scientific) was placed in the CCA to cover the dissection entry, and a second Carotid WALLSTENT was placed from the ICA to the CCA. A PRECISE stent (Cordis) was placed to connect the two stents, and the entire length was dilated with a SHIDEN balloon catheter (Fig. 2E and F).

Because the dissection extended to the carotid bifurcation, the patient developed postoperative hypotension, which was treated with

norepinephrine for 5 days. Each time her blood pressure dropped, she experienced transient left upper limb paresis and dysarthria, which were thought to be symptoms of decreased blood flow to the right cerebral hemisphere.

Retrograde Treatment for Right CCA Chronic Occlusion

Recanalization of the right CCA was performed to improve blood flow and prevent embolism.

The procedure was performed under local anesthesia. A 9-Fr Optimo catheter was guided from the right femoral artery to the brachiocephalic artery, and a 6-Fr Optimo catheter was guided from the right radial artery to the right subclavian artery for proximal protection to prevent distal embolization. The STA had a diameter of only 1 mm (Fig. 3A), was impalpable, and could not be visualized on ultrasonography. A 3-cm incision was made anterior to the ear along the course of the STA trunk, and the STA, located at the inferior margin of the zygomatic arch, was exposed while confirming the vessel location with micro-Doppler ultrasound. The STA was punctured with a 21-gauge Surflo needle (Terumo) (Fig. 3B), a CHIKAI X10 guidewire was guided through the needle, and a RADIFOCUS guidewire was then advanced. A 5-Fr Glidesheath Slender sheath (Terumo) was then placed (Fig. 3C). Using a Fencer Micro Catheter for endovascular treatment (1.9 Fr/2.6 Fr, 135 cm; Medico's Hirata) and a CHIKAI 14 guidewire, we advanced retrogradely into the CCA. The wire advanced smoothly to the proximal CCA, and an Astato XS 9–12 guidewire (tip load 12gf) (ASAHI INTECC) was guided toward the CCA origin. The wire behavior suggested that it had entered a false lumen at the CCA origin. Cone-beam CT was used to confirm the direction of the CCA, and an Astato XS 9–40 guidewire (tip load 40 gf) was used to penetrate from the CCA false lumen into the true lumen of the brachiocephalic artery (Fig. 3E).

A Headway 21/Goose Neck Snare SK 700 (7 mm, Medtronic) was advanced from the 9-Fr Optimo catheter, and the Astato XS 9–12 guidewire (40 g) was snared in the brachiocephalic artery (Fig. 3F). The Fencer (1.9 Fr/2.6 Fr, 135 cm)/Astato XS 9–12 (40 g) system was pulled through the right femoral artery, and the catheter tip



FIG. 2. Antegrade recanalization attempt for right CCA chronic occlusion and carotid artery stent placement for left CCA stenosis. **A:** A balloon-guiding catheter was placed proximal to the vertebral artery to sandwich the CCA origin. A Guidepost was inserted into the occluded CCA using a RADIFOCUS guidewire. **B:** The SL-10 microcatheter and CHIKAI 14 guidewire entered the false lumen of the CCA. **C:** Left CCA angiogram showing high-grade stenosis of the left CCA. **D:** After balloon angioplasty and deployment of a SpiderFX device in the internal carotid artery, angiography showed dissection of the CCA. **E:** With the balloon-guiding catheter expanded in the CCA for proximal protection, three stents were deployed in a connected fashion from the ICA to the CCA, followed by balloon angioplasty. **F:** Left CCA angiogram showing good expansion.

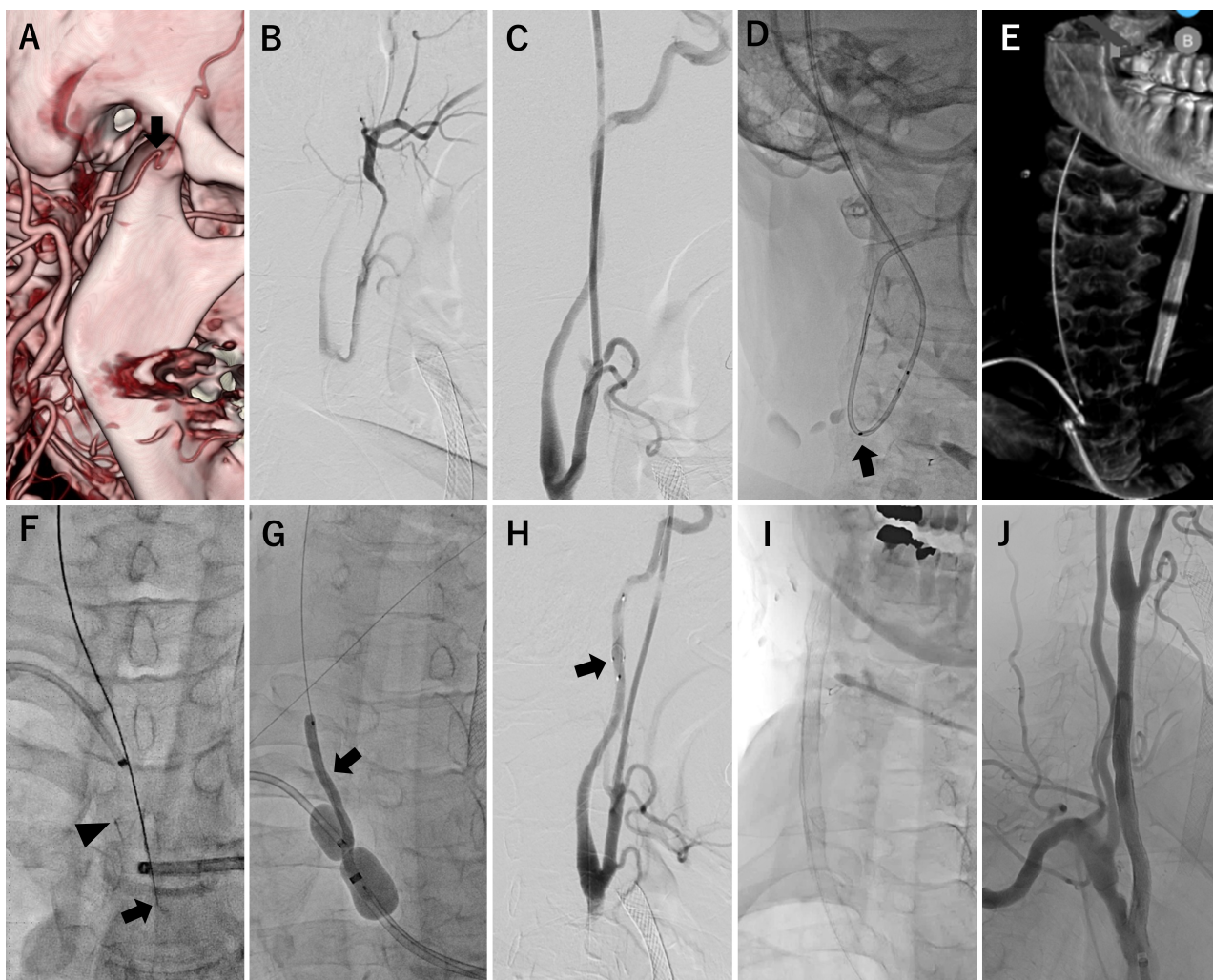


FIG. 3. Retrograde approach for right CCA chronic occlusion with carotid artery stent insertion. **A:** Three-dimensional CT angiogram showing that the diameter of the right STA at the planned puncture site (arrow) was 1.0 mm. **B:** The STA was punctured with a 21-gauge Surflo needle, and an image was taken from the Surflo. **C:** A 5-Fr Glidesheath Slender sheath was placed in the external carotid artery. **D:** A 4-Fr catheter was guided into the ICA, and an attempt was made to guide a SpiderFX device (arrow); however, it could not be guided because of a sharp bend. **E:** Cone-beam CT was used to confirm that the Fencer microcatheter was located at the origin of the CCA. **F:** An Astato XS 9–12 guidewire (arrow) was used to penetrate the occluded site. It was then captured with a snare (arrowhead) and pulled through the guiding catheter from the femoral artery approach. **G:** The balloon-guiding catheter was inflated to sandwich the CCA, and balloon angioplasty (arrow) was performed under blood flow occlusion. **H:** An external carotid artery angiogram was obtained from the STA puncture sheath. A filter protection device (arrow) was guided into the right ICA using a guidewire that was pulled through. **I:** Three stents were deployed in a connected manner. **J:** Brachiocephalic artery angiogram revealing good expansion of the CCA.

was brought outside the body. From the pulled-through microcatheter, a CHIKAI 14 guidewire (315 cm) was advanced through the 9-Fr Optimo and 5-Fr sheaths, and the Fencer microcatheter was removed.

With proximal protection using the 9-Fr Optimo and 6-Fr sheaths, the entire length of the occlusion was dilated with a Coyote ES 2.5 × 40 mm balloon catheter (Boston Scientific) (Fig. 3G). To prevent distal embolism, a SpiderFX device (4 mm) was guided into the ICA, the STA-side CHIKAI 14 guidewire (315 cm) was pulled back to the ICA bifurcation, and the ICA was selected. The SpiderFX device was then advanced and deployed (Fig. 3H).

A PRECISE 9 × 40-mm stent was placed from the ICA to the CCA, and a PRECISE 8 × 40-mm stent was placed from the CCA origin to the brachiocephalic artery. A SHIDEN 5 × 40-mm balloon was used

to perform percutaneous transluminal angioplasty three times along the entire length of the CCA, and a PRECISE 10 × 40-mm stent was deployed and placed in the mid-CCA to connect the two stents (Fig. 3I and J). The STA sheath was removed, and hemostasis was achieved with five stitches of 9-0 nylon. The patient had no clear postoperative complications and was discharged without neurological deficits. Postoperatively, dual antiplatelet therapy was continued for 3 months, followed by aspirin monotherapy.

Follow-up imaging at 3 months postprocedure (Fig. 4) confirmed excellent patency of both the right CCA and left ICA stents, with no signs of restenosis or perivascular inflammation.

Informed Consent

The necessary informed consent was obtained in this study.

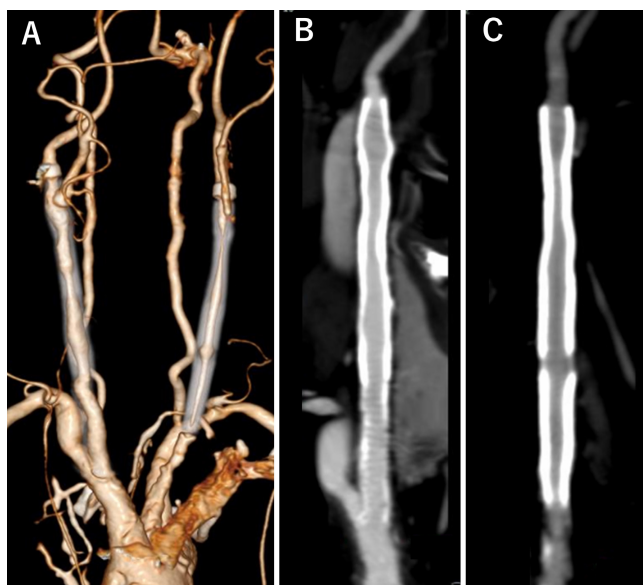


FIG. 4. Imaging findings 3 months after the procedure. **A:** Three-dimensional CT angiography volume rendering demonstrating good long-term patency of both the stented right CCA and left ICA with no evidence of restenosis. **B:** Multiplanar reconstruction (MPR) of the right CCA. **C:** MPR of the left ICA. In panels B and C, there are no signs of in-stent stenosis, indicating stable postoperative outcomes.

Discussion

Observations

This case is a rare example of successful recanalization of a long lesion chronic occlusion originating from the right CCA in a patient with Takayasu arteritis using a retrograde approach from the STA.

Takayasu arteritis is a large-vessel vasculitis that primarily affects young women and often causes severe stenosis or occlusion of the aortic arch branches. CCA origin occlusion can lead to decreased cerebral perfusion and be a source of emboli. Unlike typical atherosclerotic occlusions, inflammatory vascular lesions are accompanied by marked fibrosis, calcification, and anatomical distortion, making it often impossible for an antegrade approach to pass through the lesion. Thus, surgical treatments, such as bypass surgery, are often chosen. We believe that choosing a less invasive method is reasonable, as the frequency of stroke due to surgery is higher than that due to endovascular treatment.⁶ The mechanism of infarction in this case was believed to be embolic, with the embolus originating from a site of blood stasis in the CCA and migrating intracranially. Consequently, we concluded that simply increasing intracranial blood flow with a bypass would not prevent further infarction, and thus recanalization of the CCA was required.^{5,7}

In this case, an antegrade approach from the right femoral artery was attempted during the first treatment; however, the guidewire entered a false lumen, and the procedure was stopped because of the high risk of ICA occlusion. Because the antegrade approach was difficult, we considered an approach from the distal side, where it would be easier to secure a true lumen in the CCA.⁸ However, a direct puncture of the right CCA trunk was deemed likely to be unstable and unable to withstand kickback from catheter and wire manipulation, as a sufficient length of sheath could not be inserted toward the occluded segment. Therefore, we chose to puncture and place a sheath in the STA, which is more superficial and distal and provides a sufficient distance from

the puncture site to the occlusion. The STA approach also has the advantage of being safely exposed and allowing for hemostasis under local anesthesia with a low risk of neurovascular damage.^{9,10}

In the actual treatment, the wire, which had entered a false lumen near the CCA origin from the STA approach, was successfully advanced to penetrate toward the brachiocephalic artery. It was then snared from the antegrade approach and pulled through. This technique allowed us to safely penetrate the true lumen of the highly occluded segment and ensure secure stent placement.⁹

Furthermore, during balloon dilation, we used a balloon-guiding catheter to sandwich the right CCA origin and perform proximal protection to prevent distal embolization. This was made possible by utilizing collateral flow from the contralateral vertebral artery via the subclavian steal phenomenon. Although this method can be used for the right CCA, proximal protection is not possible in the case of a left-sided origin occlusion. This case demonstrates that a safe and effective endovascular reconstruction can be achieved for a highly inflammatory vascular lesion by combining a flexible approach with device selection tailored to the local anatomy and hemodynamics.¹¹

Although STA puncture allows relatively safe peripheral vascular access, there are potential complications to consider. As the STA runs directly under the skin, there is a risk of subcutaneous hematoma, postoperative bleeding, and pseudoaneurysm formation at the puncture site. Special care must be taken for bleeding tendencies when the procedure is performed under anticoagulant and antiplatelet therapy. Vascular injury or bleeding causing compression of surrounding tissues, as well as damage to the facial nerve or superficial temporal vein, must also be considered.^{12,13}

Furthermore, due to the small vessel diameter, catheter and sheath size selection is crucial, as the insertion of an oversized device can induce vessel rupture or thrombus formation. Postoperative hemostasis is also essential and requires secure ligation and suturing to prevent rebleeding and hematoma formation. Considering these risks, the STA can be a safe peripheral access route because it is superficial, easily visible, and crosses a relatively small number of nerves. Particularly, when used selectively based on anatomical conditions and treatment strategies, as in this case, it can provide an effective and minimally invasive approach.

We must also consider the risk of postoperative complications specific to endovascular revascularization, such as acute carotid stent thrombosis and restenosis. Although acute carotid stent thrombosis is rare, it is a potentially catastrophic event.¹⁴ Adequate dual antiplatelet therapy is considered the cornerstone of management to reduce the risk of stent thrombosis. In patients with Takayasu arteritis, the risk of occlusion may be further compounded by chronic vessel wall inflammation. Therefore, strict adherence to perioperative antithrombotic protocols is essential. In our case, we initiated dual antiplatelet therapy (aspirin and clopidogrel) 14 days prior to the procedure and continued it postoperatively.

Furthermore, stent design may play a role in long-term durability. Previous research has shown that open-cell stents are associated with significantly lower rates of restenosis compared to closed-cell stents.¹⁵ For the long-segment occlusion in the right CCA, we utilized PRECISE stents (open-cell design), aiming to minimize vessel wall irritation and reduce the risk of restenosis, thereby complementing the pharmacological strategy to ensure long-term patency.

Lessons

This case represents a rare successful example of recanalization of a CCA origin occlusion due to Takayasu arteritis using a retrograde

endovascular approach from the STA. This demonstrates that in cases in which an antegrade approach is difficult, a retrograde approach using the STA and pull-through technique can provide safe and reliable recanalization. The construction of a flexible treatment strategy and careful manipulation of endovascular devices are of utmost importance, especially for the complex anatomy and fibrosis characteristics of Takayasu arteritis. This strategy may be a useful treatment option for similar right CCA origin occlusive lesions.

Acknowledgments

We used Gemini Advanced for English proofreading, grammatical correction, and stylistic refinement of the paper. No scientific content or data were generated by AI.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Tsukada, Aimi, Isozawa. Acquisition of data: Tsukada, Aimi, Kato, Isozawa. Analysis and interpretation of data: Aimi, Isozawa. Drafting the article: Tsukada, Isozawa. Critically revising the article: Tsukada, Isozawa. Reviewed submitted version of manuscript: Tsukada, Ishikawa, Isozawa. Approved the final version of the manuscript on behalf of all authors: Tsukada. Statistical analysis: Isozawa. Administrative/technical/material support: Aimi, Yokoyama, Isozawa. Study supervision: Tsukada, Aimi, Isozawa, Nagatani.

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