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Case Report

A Case of Acute Atherosclerotic Basilar Artery Occlusion Treated by Angioplasty with a Stent Retriever and Combined Antithrombotic Therapy

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Objective: The optimal treatment strategy for large-vessel occlusion (LVO) related to intracranial atherosclerotic disease (ICAD), particularly for tandem lesions that complicate access and device delivery, remains unclear. We report a case in which angioplasty with a stent retriever (SR) and combined antithrombotic therapy was effective in treating re-occlusion associated with dissection of the residual stenosis after thrombectomy for acute atherosclerotic occlusion of the basilar artery (BA) with the left vertebral artery (VA) stenosis.

Case Presentation: An 80-year-old woman was brought to our hospital with progressively worsening consciousness and tetra-paresis. MRA revealed occlusion of the middle to proximal portion of the BA. The patient underwent percutaneous transluminal angioplasty using a balloon catheter for severe stenosis at the origin of the left VA, followed by mechanical thrombectomy for the BA occlusion. While initial recanalization was achieved, residual stenosis in the proximal portion of the BA led to re-occlusion. An attempt at angioplasty with a balloon catheter failed to reach the stenotic segment due to stenosis and tortuosity of the left VA. Consequently, the SR was redeployed into the BA, and a loading dose of antiplatelet agents and intravenous anticoagulant were administered during prolonged deployment. Following the confirmation of BA patency, the SR was re-sheathed and removed. The patient achieved remarkable improvement in consciousness and tetra-paresis without postoperative re-occlusion of the BA.

Conclusion: Angioplasty with a SR and combined antithrombotic therapy may be a useful treatment option for ICAD-related LVO, particularly in cases such as tandem lesions that hinder access and make distal balloon catheter navigation challenging.

Keywords ▸ angioplasty with a stent retriever, mechanical thrombectomy, large vessel occlusion, intracranial atherosclerotic disease, tandem lesion

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Introduction

Mechanical thrombectomy has been established as the gold standard for the treatment of large-vessel occlusion (LVO) caused by cardioembolic stroke, as demonstrated by recent randomized controlled trials. However, the efficacy of mechanical thrombectomy for LVO due to intracranial atherosclerotic disease (ICAD) is limited, and optimal treatment for ICAD-related LVO remains unclear. Additionally, in the treatment of ICAD-related LVO, there are often challenges in maintaining recanalization and accessing the lesion, especially in cases with tandem lesions. Here, we report a case in which angioplasty with a stent retriever (SR) and combined antithrombotic therapy were

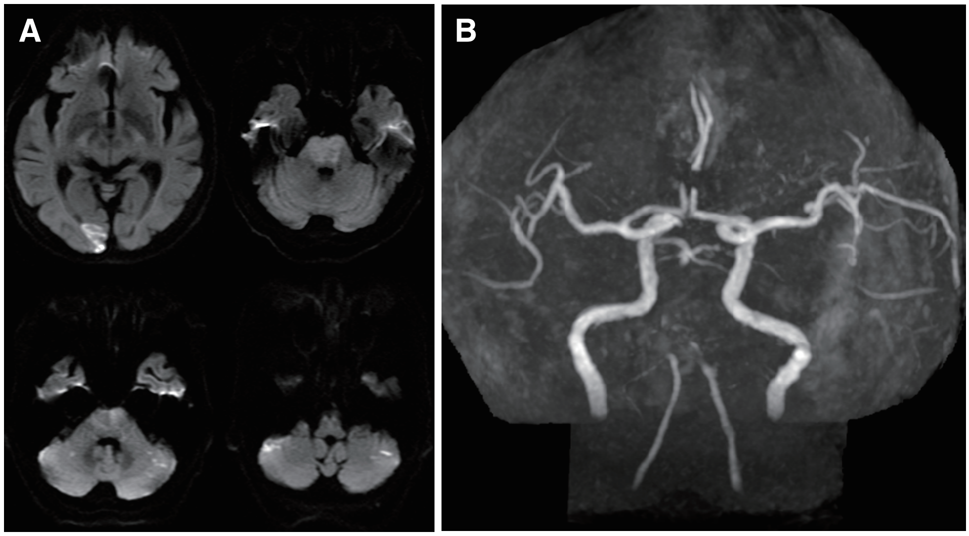

Fig. 1 Images on admission. (**A**) Axial diffusion-weighted images showed acute cerebral infarction in the bilateral pons, the cerebellar hemispheres, and the right occipital lobe. (**B**) MRA showed a signal deficit from the middle to the proximal portion of the BA. BA, basilar artery

effective in treating re-occlusion associated with dissection of the residual stenosis after thrombectomy for acute atherosclerotic occlusion of the basilar artery (BA) with the left vertebral artery (VA) stenosis. Approval for this study was obtained from the ethics review board of Hakodate Shintoshi Hospital (approved No. 20240513B1).

Case Presentation

An 80-year-old woman was brought to our hospital by ambulance 4 hours after initially complaining of feeling unwell and subsequently experiencing a gradual decline in consciousness. She had a medical history of unruptured cerebral aneurysm and hypertension, but no history of taking antithrombotic medication.

Upon arrival, her blood pressure was 136/84 mmHg, heart rate was 93 beats/min (regular), Japan Coma Scale (JCS) was 30, and Glasgow Coma Scale (GCS) was 7 (E2V1M4). She exhibited an absence of verbal response and severe tetra-paresis with a National Institutes of Health Stroke Scale (NIHSS) score of 28.

MRI revealed hyperintense areas in the bilateral pons, cerebellar hemispheres, and the right occipital lobe on diffusion-weighted images (**Fig. 1A**). The posterior circulation Alberta stroke program early CT score (pc-ASPECTS) was 5. MRA showed a signal deficit from the middle to the proximal portion of the BA (**Fig. 1B**). We diagnosed acute occlusion of the BA and opted for mechanical thrombectomy.

The right femoral artery was punctured, and a 6-Fr Fubuki XF Dilator Kit (Asahi Intecc, Aichi, Japan) was inserted within 42 minutes of admission. Systemic heparinization was performed by administering 4000 units of heparin, resulting in an activated clotting time extension from 108 to 266 seconds. Using a 5-Fr JB2 (Medikit, Tokyo, Japan) as an inner catheter, we initially guided it into the left internal carotid artery. Retrograde angiography via the left posterior communicating artery revealed that the distal end of the BA was patent, but it was occluded at the middle portion, including the origin of the anterior inferior cerebellar artery (**Fig. 2A**). Subsequent antegrade angiography was performed from the right VA, revealing that the proximal portion of the BA was occluded, and the right VA had a narrower diameter at the distal end compared to the left side and curved to merge with the BA (**Fig. 2B**). Given the left-sided dominance, we opted to approach from the left VA. During left subclavian artery angiography, a severe stenosis was identified at the origin of the left VA (**Fig. 2C**). While the 5-Fr JB2 could pass through this stenosis, the 6-Fr Fubuki XF could not. The Fubuki XF was left in the left subclavian artery, and attempts were made to pass through the stenosis using Salva 60 (Nipro Corporation, Osaka, Japan), Phenom 21 (Medtronic, Minneapolis, MN, USA), and Chikai 14 (Asahi Intecc) coaxially. However, the Salva 60 also could not pass through the stenosis. Then, it was decided to perform percutaneous transluminal angioplasty (PTA) for the stenosis at the origin of the left VA. The normal vessel diameter of the left VA was 3.9 mm, with a

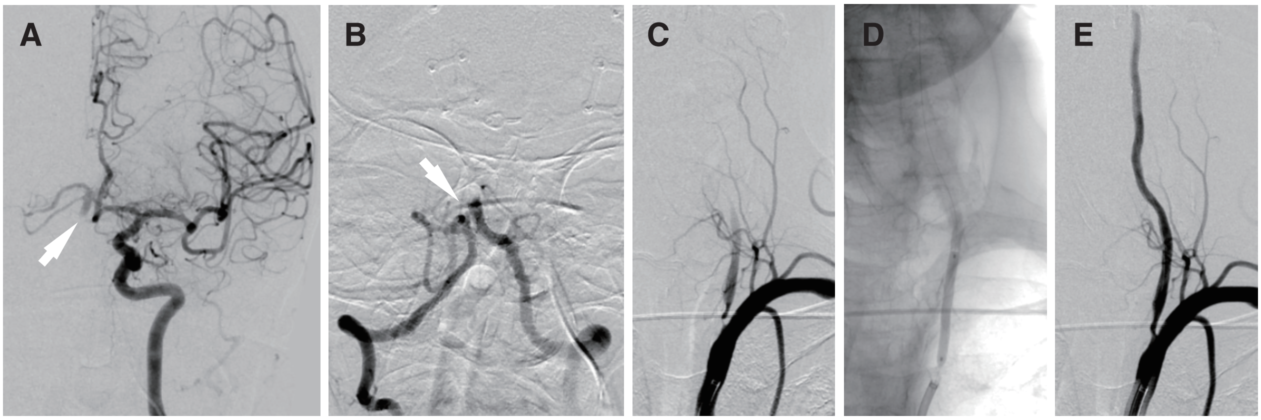

Fig. 2 Intraprocedural images (1). (**A**) Frontal view of left internal carotid angiography revealed that the distal end of the BA was patent, but it was occluded at the middle portion, including the origin of the AICA (arrow). (**B**) Frontal view of right vertebral angiography revealed that the proximal portion of the BA was occluded, and the right VA had a narrower diameter at the distal end compared to the left side and curved to merge with the BA (arrow). (**C**) Left subclavian angiography showed stenosis at the origin of the left VA. (**D** and **E**) PTA for the left VA stenosis was performed using a Shiden 3.0/30 mm at 8 atmospheres for 60 seconds. AICA, anterior inferior cerebellar artery; BA, basilar artery; PTA, percutaneous transluminal angioplasty; Shiden, Kaneka Medix, Osaka, Japan; VA, vertebral artery

stenotic segment measuring 0.6 mm, resulting in a stenosis rate of 85%. After crossing the lesion with Chikai 14, PTA was performed using a Shiden 3.0/30 mm (Kaneka Medix, Osaka, Japan) at 8 atmospheres for 60 seconds (**Fig. 2D** and **2E**). While the 6-Fr Fubuki XF remained unable to pass through the left VA origin, the Salva 60 became navigable. However, it could not advance beyond the V2 segment due to stenosis at the origin of the VA and distal tortuosity and was left in place. Lesion crossing of the occluded portion of the BA was then attempted using Chikai 14 and Phenom 21. Subsequently, a Solitaire X 6.0/40 mm (Medtronic) was deployed from the top of the BA to the left VA and retrieved, capturing a thrombus into the aspiration catheter. Effective recanalization was confirmed on left VA angiography, but residual stenosis remained in the proximal portion of the BA (**Fig. 3A**). The SR displayed adherent thrombus, which appeared to be in situ thrombus (**Fig. 3B**). Five minutes later, a repeat left VA angiography revealed re-occlusion of the distal portion of the BA stenosis (**Fig. 3C**). Attempted angioplasty with an Unryu XP 2.0/10 mm (Kaneka Medix) was unsuccessful. Because the difference in length between the tips of the aspiration catheter and the balloon catheter was only about 14 cm even without connectors, the aspiration catheter could not advance distally, and as a result, the balloon catheter could not reach the lesion. Therefore, lesion crossing was immediately performed again, and the Solitaire X was redeployed from the top of the BA to the left VA (**Fig. 3D**). Aspirin 200 mg and prasugrel 20 mg were administered via a nasogastric tube, followed by a continuous intravenous infusion of argatroban. The SR was left deployed for 30 minutes, achieving BA patency (**Fig. 3E**). It was then carefully removed by re-sheathing with the micro-catheter gently, leaving only the micro-guidewire in the true rumen. After another 30 minutes, BA patency was confirmed, and the micro-guidewire was also removed as antegrade blood flow remained established without clot formation or elastic recoil (**Fig. 3F**). Although stenosis persisted at the left VA origin, no elastic recoil was observed. This concluded the procedure. The total time from puncture to initial recanalization of the BA was 43 minutes, and 92 minutes to the second steady recanalization.

Postoperatively, improvement was noted in consciousness and tetra-paresis, with a NIHSS score of 7. On the day following the procedure, MRI revealed micro-embolisms in the bilateral cerebellar hemispheres, but no intracerebral hemorrhage or re-occlusion of the BA (**Fig. 4A** and **4B**). Dual antiplatelet therapy with aspirin 100 mg and prasugrel 3.75 mg was continued. The patient's condition steadily improved, with no stroke recurrence or worsening of symptoms. Two weeks after the initial stroke onset, follow-up MRA revealed re-stenosis of the BA (**Fig. 5A** and **5B**). Upon review of the MRA source images, a pseudo-lumen was observed on the right lateral side of the vessel wall, indicating dissection within the stenotic plaque (**Fig. 5A** and **5B**). It was determined that the extension of the pseudo-lumen led to the narrowing of the true lumen. Although asymptomatic, a Wingspan Stent (Stryker, Kalamazoo, MI, USA) was placed 3 weeks after the onset (**Fig. 5C** and **5D**). After several months of rehabilitation,

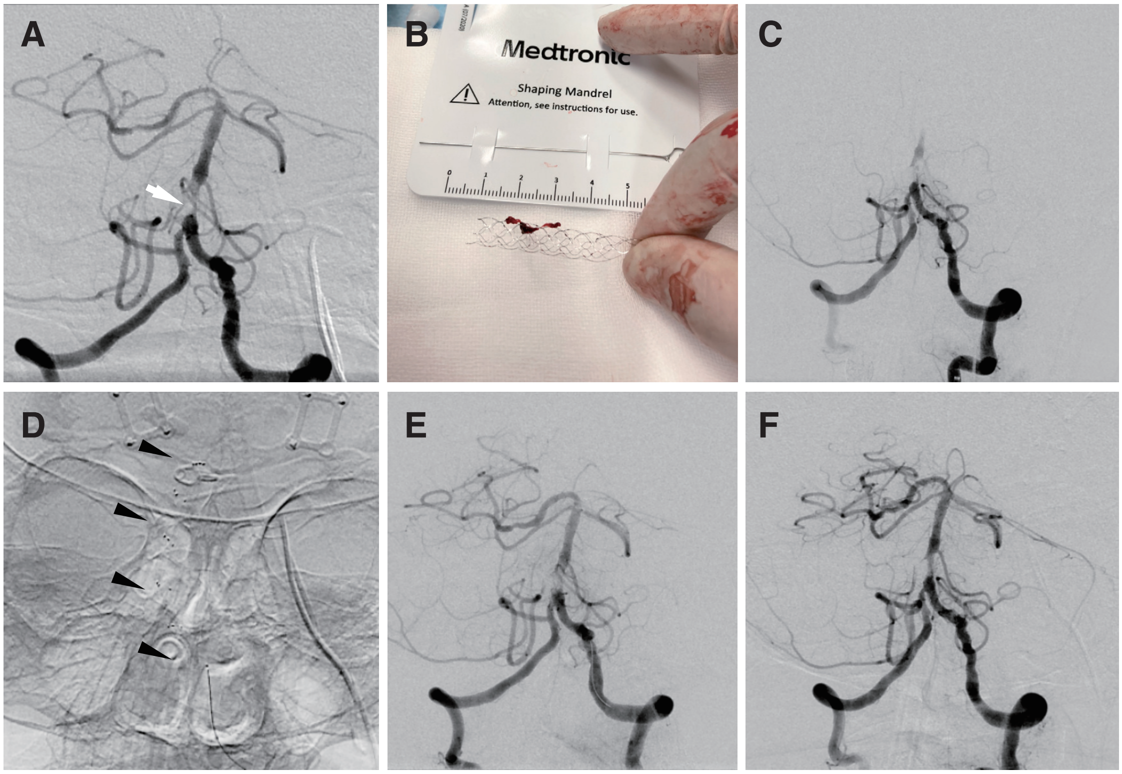

Fig. 3 Intraprocedural images (2). (**A**) Frontal view of light vertebral angiography revealed that effective recanalization of the BA was achieved by mechanical thrombectomy, but residual stenosis was observed in the proximal portion of the BA (arrow). (**B**) There was a clot on the SR that appeared to be an in-situ thrombus. (**C**) Five minutes after thrombectomy, a frontal view of light vertebral angiography showed that the BA was re-occluded. (**D**) A Solitaire X 6.0/40 mm was deployed from the top of the BA to the left VA (arrowhead). (**E**) Frontal view of light vertebral angiography showed the patency of the BA during the SR deployment. (**F**) Frontal view of light vertebral angiography showed the maintained patency of the BA without clot formation or elastic recoil after re-sheathing and removing the SR. BA, basilar artery; Solitaire, Medtronic, Minneapolis, MN, USA; SR, stent retriever; VA, vertebral artery

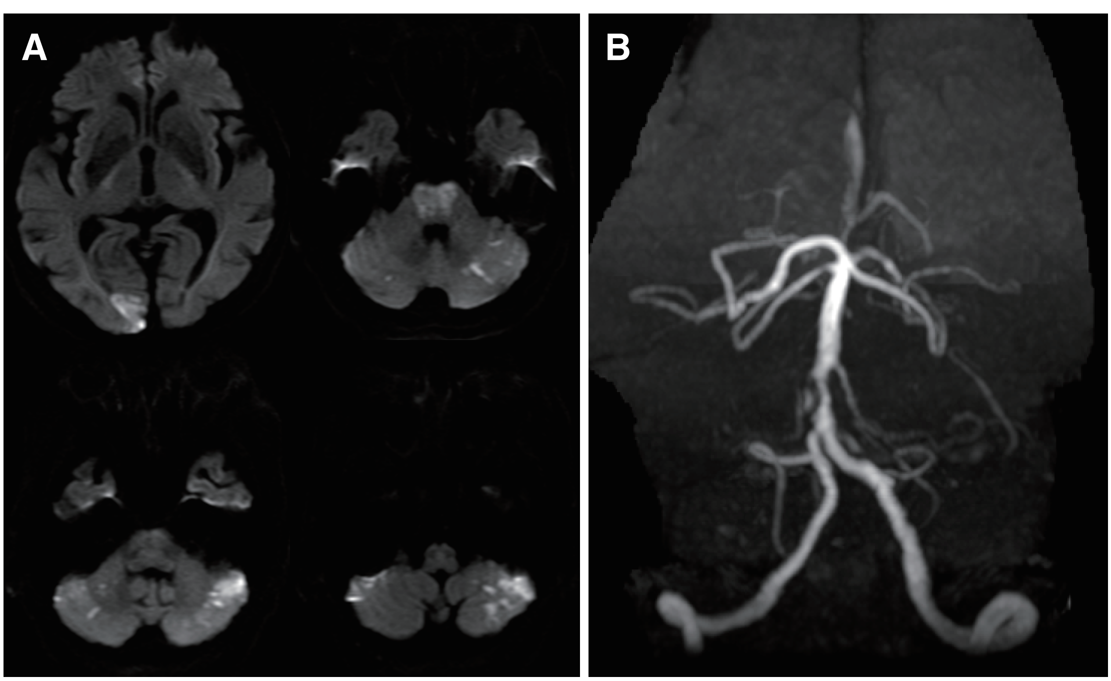

Fig. 4 Postprocedural images (1). (**A**) Axial diffusion-weighted images showed micro-embolisms in the bilateral cerebellar hemispheres, but no intracerebral hemorrhage. (**B**) MRA showed residual stenosis in the BA, but it remained patent. BA, basilar artery

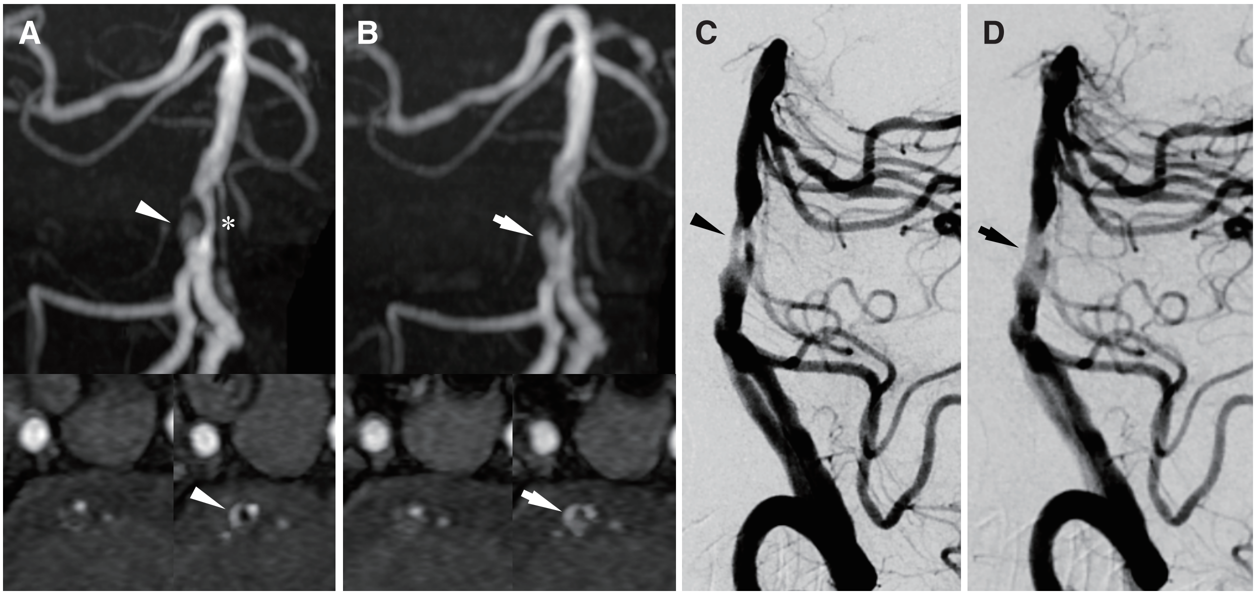

Fig. 5 Postprocedural images (2). (**A**) MRA and MRA source images on the day following the procedure showed residual stenosis (asterisk) in the BA. A pseudo-lumen was observed on the right lateral side of the vessel wall (white arrowhead), indicating dissection within the stenotic plaque. (**B**) Follow-up MRA and MRA source images after 2 weeks from the onset showed progression of the stenosis. The extension of the pseudo-lumen (white arrow) was thought to have led to the narrowing of the true lumen. (**C**) Lateral view on left VA angiography before Wingspan Stent placement showed severe stenosis in the proximal portion of the BA (black arrowhead). (**D**) Stent placement resulted in improvement of the stenosis (black arrow). BA, basilar artery; VA, vertebral artery; Wingspan Stent, Stryker, Kalamazoo, MI, USA

the patient was discharged with moderate right upper and mild right lower limb paralysis, achieving a modified Rankin Scale grade of 3 and the ability to walk independently.

Discussion

Mechanical thrombectomy for LVO due to cardioembolic stroke is already an established treatment, and its efficacy for BA occlusion has been demonstrated by randomized controlled trials, ATTENTION[1] and BAOCHE.[2] On the other hand, mechanical thrombectomy for ICAD-LVO often results in recanalization failure, requiring adjuvant angioplasty or stenting, which can lead to high complication and mortality rate,[3] posing a challenge in reperfusion therapy. Additionally, the clinical subtype of BA occlusion is predominantly atherosclerotic, accounting for over half of all cases.[4] It has been reported that 25% of BA occlusions caused by ICAD involve tandem lesions,[5] which can complicate device delivery and access to the lesion.

Recent case reports have demonstrated the effectiveness of mild angioplasty using SR deployment for ICAD-related LVO.[6–10] This technique involves dilating the stenosis with moderate radial force of the SR, followed by re-sheathing the SR with the micro-catheter gently to minimize friction against the stenosis, preventing damage to the vascular endothelium that can induce clot formation.[3] Aggressive PTA with a conventional non-compliant balloon has been reported to carry potential risks of vessel rupture, dissection, and plaque shift.[11,12] Angioplasty with an SR has the advantage of reducing these risks and maintaining cerebral blood flow during the procedure.[6–10] In addition, SRs, compared to balloon catheters, have superior distal reachability because they can be guided and deployed with micro-catheters and may be more effective in difficult-to-access cases such as tandem lesions. In this case, due to the inability to advance the aspiration catheter distally and the failure to navigate a balloon catheter to the residual stenosis, angioplasty with an SR was chosen. This approach proved successful, demonstrating its potential effectiveness.

One crucial factor in the effectiveness of this method is achieving reliable immediate flow restoration (IFR) after SR deployment. Failure to achieve IFR may indicate poor adherence of the SR to the vessel wall or insufficient radial force of the SR against the stenosis. Additionally, if repeated angiography shows occlusion or delayed flow, the effectiveness of this method is considered low, and alternative approaches, including conventional balloon PTA, should be considered. Another critical consideration is re-sheathing SR. Passing the SR through a stenotic lesion

Table 1 Clinical characteristic of literature cases demonstrating the effectiveness of angioplasty with SRs

Author (year)	Age, sex	Target vessel	SR (mm)	SR deployment time	Antithrombotic therapy	Additional therapy in subacute/chronic phase
Raychev (2018)[6]	92, F	BA	Solitaire FR 4/20	15 min	Not described	Non
Moteki et al. (2020)[7]	44, M	MCA	Trevo Xp 3/20	5 min	ASA 200 mg, CLP 300 mg	STA-MCA anastomosis
Tanaka et al. (2022)[8]	73, M	ICA	Solitaire Platinum 6/40	30 min	ASA 200 mg, CLP 150 mg	Non
Tanaka et al. (2022)[8]	60, M	ICA	Solitaire Platinum 6/40	10 min	ASA 200 mg, CLP 300 mg	Non
Morofuji et al. (2023)[9]	88, M	VA	Solitaire	30 min	Dural antiplatelet therapy	Wingspan stenting
Sen et al. (2024)[10]	85, M	MCA	Trevo NXT 6/37	15 min	ASA 200 mg, apixaban 10 mg	Non
Our case	80, F	BA	Solitaire X 6/40	30 min	ASA 200 mg, PRAS 20 mg	Wingspan stenting

ASA, acetylsalicylic acid (aspirin); BA, basilar artery; CLP, clopidogrel; ICA, internal carotid artery; MCA, middle cerebral artery; PRAS, prasugrel; Solitaire, Medtronic, Minneapolis, MN, USA; SR, stent retriever; STA, superficial temporal artery; Trevo, Stryker, Kalamazoo, MI, USA; VA, vertebral artery; Wingspan Stent, Stryker

can cause vascular endothelium damage, potentially leading to clot formation. Specifically, the repeated passage of the SR can damage inflamed plaques, which may provoke further platelet activation and arterial dissection.[3,13] In this case, dissection at the stenotic lesion was observed on postoperative MRA, which is considered to occur during the first pass with the SR. If additional passes with the SR had been made, it might have worsened the dissection. Re-sheathing SR is important to mitigate these risks. However, if thrombus formation is observed within the SR, there is a risk of distal embolism upon re-sheathing. Thus, careful observation during repeat angiography after SR deployment is necessary.

The success of angioplasty with SR hinges on effective antithrombotic therapy during prolonged deployment. Rapid inhibition of platelet aggregation is key in this method, and several previous case reports have utilized loading doses of aspirin and clopidogrel.[7,8] In this case, we administered loading doses of aspirin 200 mg and prasugrel 20 mg, in addition to continuous intravenous infusion of argatroban. Prasugrel rapidly reaches peak blood concentration, attaining its peak within 30 minutes after administration, and the interval until its effects is shorter compared to clopidogrel, which takes about 1 hour.[14] Furthermore, prasugrel has the advantage of being less affected by genetic polymorphism of CYP2C19 and having less resistance compared to clopidogrel.[15] Asai et al. have reported the efficacy and safety of prasugrel in emergent endovascular treatment for ICAD,[16] suggesting that loading with prasugrel may also be effective in this method. However, prasugrel is not approved for acute ischemic stroke, and the optimal loading dose remains unclear. Regarding the extra-indication use of prasugrel, we have obtained approval from the ethics review board of our hospital.

In previous case reports, there is some variability in the techniques used, and they have not been fully optimized (**Table 1**). One of the variations is the type of SR. Both Solitaire (Medtronic) and Trevo (Stryker) have been used, but their relative superiority is not yet clear. We chose the Solitaire, based on the efficacy of stenting without retrieval using Solitaire FR for ICAD-LVO as reported by Kim et al.[17] Solitaire can be deployed easily without a push technique, potentially reducing damage to plaque due to its mild radial force.[8,9] By contrast, Trevo offers excellent visibility under fluoroscopic visualization, and post-deployment angiography is useful in estimating the cause of stenosis.[10] Tigertriever (Rapid Medical, Yokneam, Israel), a unique SR with manual control of radial force, has also shown utility for ICAD-LVO,[18] suggesting that such SRs might be beneficial in certain cases. Regarding the size of SR, it should be selected based on the diameter of the target vessel to ensure appropriate radial force, similar to conventional mechanical thrombectomy. In this case, a 6 mm diameter was chosen with an emphasis on the radial force of the SR, given that the normal vessel diameter of the proximal BA was 3.2 mm and the presence of ICAD was not initially recognized. Dissection ultimately occurred at the stenotic lesion, and the strong radial force may have influenced this outcome. If reducing the risk of endothelium damage was prioritized, a smaller diameter might have been a better choice; however, this requires further investigation. Another is the deployment time of SR, which varies from 5 to 30 minutes in reported cases with no consistent consensus. We use a deployment time of 30 minutes as a guideline based on the pharmacological effects of antiplatelet drugs, specifically the time required for prasugrel to reach its peak blood concentration.

The decision to perform intracranial stenting for residual stenosis remains controversial. Currently, the only approved intracranial stent in Japan is the Wingspan Stent (Stryker), which is indicated for use only in rescue stenting for vessel dissection, acute occlusion, or impending occlusion occurs during angioplasty, or for retreatment after angioplasty when no other effective treatment options are available.[19] In this case, since the stenosis progressed due to extension of the pseudo-lumen associated with dissection in the subacute phase, and re-occlusion was expected to be a fatal outcome, Wingspan Stent placement was performed. In general, if there is no recurrence of restenosis or stroke despite medical treatment, intracranial stenting should be avoided. The point to emphasize is that this method allowed us to avoid hyperacute phase stent placement, which is known for a high incidence of stenting-related complications. Since the efficacy and findings of angioplasty with an SR have only been demonstrated in a limited number of case reports, accumulation of additional cases and further investigation, including optimization of the technique, are necessary.

Conclusion

Angioplasty with an SR and combined antithrombotic therapy may be a useful treatment option for ICAD-related LVO, particularly in cases such as tandem lesions that hinder access and make guiding a balloon catheter distally challenging.

Informed Consent

Informed consent was obtained from the patient and her family to publish this clinical report.

Disclosure Statement

The authors declare no conflict of interest.

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