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Case Report

Stent Retriever Angioplasty for Intracranial Atherosclerotic Disease-Related Medium Vessel Occlusion: A Case Report and Literature Review

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Objective: Stent retriever (SR) angioplasty is an adjunctive technique for acute large vessel occlusion stroke due to underlying intracranial atherosclerotic disease (ICAD-LVO). Prolonged SR deployment maintains blood flow distal to the atherosclerotic lesion until the antiplatelet agent has exerted its effect. Although SR angioplasty for ICAD-LVO has been reported, few reports are available on SR angioplasty for medium vessel occlusion stroke due to underlying ICAD (ICAD-MeVO). Here, we describe a case of SR angioplasty for acute occlusion of the left M2 segment of the middle cerebral artery (MCA) due to underlying ICAD.

Case Presentation: A 79-year-old man with a history of left MCA M2 segment stenosis presented with motor aphasia and dysarthria. Diffusion-weighted MRI showed no high-signal intensity areas, and MRA showed occlusion of the left MCA M2 segment. The patient was diagnosed with ICAD-MeVO. After performing an MRI, the patient's symptoms progressed to total aphasia. SR angioplasty was performed for the occlusion of the left M2 segment of the MCA. Diffusion-weighted MRI the day after the procedure showed a small area of high-signal intensity exclusively in the left putamen, while MRA confirmed recanalization of the left MCA M2 segment. Aphasia improved after the procedure. No re-occlusion was observed for 90 days, and the modified Rankin Scale score at 90 days was 2.

Conclusion: SR angioplasty appears to be a safe option for managing MCA M2 segment occlusion.

Keywords intracranial atherosclerotic disease, medium vessel occlusion, stent retriever angioplasty

Introduction

Large vessel occlusion (LVO) strokes due to underlying intracranial atherosclerotic disease (ICAD-LVO) account for 15%–30% of all LVOs in East Asia.[1,2] Although the proportion of ICAD in medium vessel occlusions (MeVOs) has not been sufficiently reported, they differ from embolic strokes in that perioperative antithrombotic therapy is required in addition to adjunctive techniques such as bailout intracranial angioplasty or stenting.[3]

Stent retriever (SR) angioplasty, one of the adjunctive techniques,[4–6] entails extended deployment of an SR to maintain blood flow distal to the atherosclerotic lesion, providing a window for antiplatelet therapy to become effective. SR angioplasty for LVO has been previously reported, but reports on the application of this procedure for MeVO due to ICAD (ICAD-MeVO) are rare.

Here, we describe a case of SR angioplasty for acute occlusion of the left M2 segment of the middle cerebral artery (MCA) due to underlying ICAD.

Case Presentation

A 79-year-old man with a history of hypertension and dyslipidemia presented to our hospital with motor aphasia

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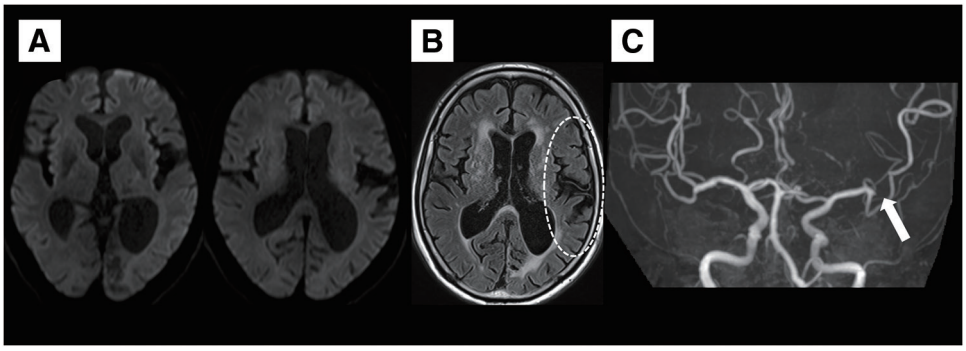

Fig. 1 Baseline MRI. (**A**) Diffusion-weighted MRI showed no high-signal intensity areas. (**B**) FLAIR imaging revealed HVS in the left MCA territory (white dotted circle). (**C**) MRA showed occlusion of the left MCA M2 segment (white arrow). HVS, hyperintense vessel sign; MCA, middle cerebral artery

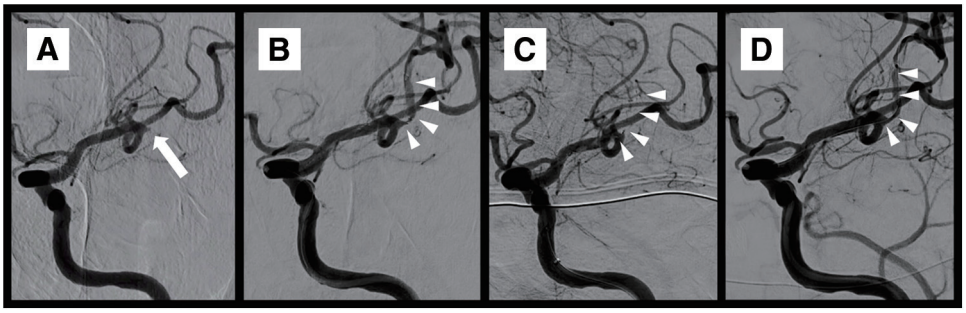

Fig. 2 Summary of the SR angioplasty procedure. (**A**) Initial angiography showed occlusion of the left MCA M2 segment (white arrow). (**B**) Deployment of the Solitaire X stent restored blood flow distal to the atherosclerotic lesion (white triangle). (**C**) After a few minutes of waiting, the inside of the Solitaire X stent was occluded by a thrombus (white triangle). (**D**) The SR was resheathed into the microcatheter and replaced with a microwire to secure the distal lesion (white triangle). If the vessel appeared to be reoccluded after a few minutes of waiting, the SR was deployed as in (**B**). MCA, middle cerebral artery; SR, stent retriever

and dysarthria 657 minutes after his last known well time; his National Institute of Health Stroke Scale (NIHSS) score[7] was 5. He had developed a large artery atherosclerosis (LAA) stroke due to MCA M2 segment stenosis a month earlier. He had received dual antiplatelet therapy with aspirin and clopidogrel as acute treatment, followed by aspirin therapy for secondary prevention. Diffusion-weighted MRI, performed 22 minutes after arrival, showed no areas with high-signal intensity (**Fig. 1A**) and FLAIR imaging revealed hyperintense vessel sign (HVS)[8] in the left MCA region (**Fig. 1B**). MRA showed occlusion of the left MCA M2 segment (**Fig. 1C**). The patient was diagnosed with recurrent LAA due to MCA M2 segment stenosis, also known as ICAD-MeVO. Thirty minutes after the MRI, the patient's symptoms progressed to total aphasia and his NIHSS score worsened to 11. Intravenous thrombolysis was contraindicated due to a history of ischemic stroke within a month. Therefore, endovascular therapy was performed for the left MCA M2 segment occlusion (hospital arrival to groin puncture time was 95 minutes).

A 9-Fr balloon guide catheter (OPTIMO EPD FLEX; Tokai Medical Products, Aichi, Japan) was guided to the cervical portion of the left internal carotid artery. Initial angiography showed occlusion in one of the three branches of the left MCA M2 segment (**Fig. 2A**). A microcatheter (Synchro SELECT; Stryker, Kalamazoo, MI, USA) was advanced distal to the occlusion site and an SR (Solitaire X 3*40 mm; Medtronic, Minneapolis, MN, USA) was deployed. Immediate flow restoration was achieved, but the SR did not fully expand (**Fig. 2B**), suggesting ICAD as the underlying pathology. Therefore, aspirin 200 mg and clopidogrel 300 mg were administered via a nasogastric tube and sodium ozagrel 80 mg was administered intravenously. Ten minutes later, angiography showed thrombotic occlusion of the SR (**Fig. 2C**). Attempts to retrieve the SR were met with strong resistance, and due to the risk of vascular traction injury, the SR was resheathed into a microcatheter. The lesion was reoccluded within minutes (**Fig. 2D**), and the SR was similarly deployed in the occluded area to restore blood flow to the distal portion. Finally, after the

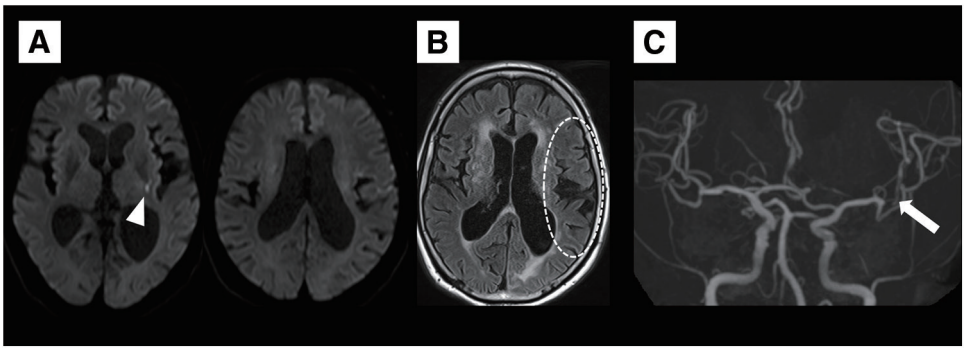

Fig. 3 MRI the day after endovascular therapy. (**A**) Diffusion-weighted MRI showed a small high-signal intensity area in the left putamen (white triangle). (**B**) FLAIR imaging revealed the resolution of the HVS in the left MCA territory (white dotted circle). (**C**) MRA showed that the left MCA M2 segment maintained recanalization, although its origin was severely stenosed (white arrow). HVS, hyperintense vessel sign; MCA, middle cerebral artery

Table 1 Summary of case reports on SR angioplasty

Author (year)	Age/Sex	NIHSS score	Occlusion site	IVT	SR device	Number of SR angioplasty procedures	APT during procedure	mRS score at 90 days
Moteki et al. (2020)[4]	44/Male	NA	R M1	(–)	Trevo XP 3/20 mm	1	ASA 200 mg CLP 300 mg	NA
Tanaka et al. (2022)[5]	73/Male	14	L ICA	(–)	Solitaire Platinum 6/40 mm	1	ASA 200 mg CLP 150 mg	2
	60/Male	30	L ICA	(–)	Solitaire Platinum 6/40 mm	3	ASA 200 mg CLP 300 mg	0
Morofuji et al. (2023)[6]	88/Male	27	R VA	NA	Solitaire	NA	NA	2
Our case	79/Male	11	L M2	(–)	Solitaire X 3/40 mm	4	ASA 200 mg CLP 300 mg	2

APT, antiplatelet therapy; ASA, acetylsalicylic acid; CLP, clopidogrel; ICA, internal carotid artery; IVT, intravenous thrombolysis; L, left; mRS, modified Rankin Scale; NA, not applicable; NIHSS, National Institutes of Health Stroke Scale; R, right; SR, stent retriever; VA, vertebral artery

fourth deployed SR was resheathed into the microcatheter, recanalization of the MCA M2 segment was maintained for 30 minutes, and the procedure was completed (groin puncture to final angiography time was 174 minutes).

MRI performed the day after the procedure showed a small area of high-signal intensity only in the left putamen on diffusion-weighted sequence (**Fig. 3A**), and the HVS disappeared on FLAIR imaging (**Fig. 3B**). MRA revealed that the left MCA M2 segment remained recanalized (**Fig. 3C**). After the procedure, aspirin 100 mg and clopidogrel 75 mg were continued and the patient's symptoms improved to an NIHSS score of 2 at discharge. Stroke recurrence was not observed at the 90-day follow-up, and the modified Rankin Scale (mRS) score at 90 days was 2.

Discussion

This report describes a patient who underwent SR angioplasty for ICAD-MeVO. Previous reports of SR angioplasty (**Table 1**) included middle-aged to older male patients with moderate-to-severe symptoms and NIHSS scores of 10 or higher. No cases of concomitant intravenous thrombolysis were reported. Aspirin and clopidogrel were administered before or during the procedure in all cases. Solitaire SRs were used except for one case in which the Trevo XP (Stryker) was used. The number of SR angioplasty procedures varied, with some cases maintaining good recanalization after only one procedure. The relationship to the timing of antiplatelet medication administration needs to be investigated. In all cases, the mRS score at 90 days was 0–2.

Some reports have suggested that SR is more efficient as a first-line strategy for ICAD-LVO,[9] while others have suggested that SR is equivalent to contact aspiration[10,11]; SR is superior in that it allows confirmation of the vascular morphology and a second-line strategy can be considered.[12] When ICAD is suspected after deployment of SR, SR angioplasty is more cost-effective than using a new device such as a balloon or stent.

Bailout intracranial angioplasty or stenting is frequently performed as an adjunctive treatment for ICAD-LVO,[12] but it is effective and is often complicated by symptomatic intracranial hemorrhage and artery dissection.[13] Rescue angioplasty for MeVO is particularly difficult because of the limited diameter of the "medium vessel," which can be less than 2.0 mm.[14] Recent reports have described the use of a novel device, the TG dilator (T.G. Medical, Tokyo, Japan), as an alternative to balloon angioplasty or rescue stenting for ICA or MCA M1 segment stenosis.[15] However, its safety in smaller vessels, such as the MCA M2 segment, remains undetermined. The TIGERTRIEVER (Rapid Medical, Yokneam, Israel), an SR with adjustable radial force, has been developed and is effective for acute ischemic stroke.[16] Therapy with "stentplasty" using the TIGERTRIEVER was reported to be successful for ICAD, including MCA M2 segment occlusion in 24% of cases.[17] No cases of dissection or other neurological complications were reported in this article. Although "stentplasty" is reported to be safe, radial forces increase compared to those of conventional SRs.[17] MeVO has other anatomical characteristics besides its small vessel diameter, such as pronounced tortuosity and multiple branching points.[18] Therefore, to avoid the potential complications associated with vessel straightening and elongation, deploying a conventional SR and resheathing without retrieval may be viable options.

Our patient required a total of 4 SR angioplasty procedures to maintain recanalization. This may have been due to the insufficient antithrombotic therapy administered during the procedure. SR angioplasty allows time for antiplatelet therapy to take effect, and prompt administration of antiplatelets before or during the procedure should be considered.[3] Dual antiplatelet therapy with aspirin and clopidogrel is commonly used for ICAD.[12] However, approximately 60% of East Asians carry *CYP2C19* loss-of-function alleles and are refractory to clopidogrel treatment, with a higher rate of recurrent ischemic stroke than non-carriers.[19] Another P2Y12 receptor inhibitor, prasugrel, has the advantage of a faster onset of action and less variability in patient response.[20] However, it is not recommended that prasugrel be used as a first choice P2Y12 in all patients. The TRITON-TIMI38 study found that prasugrel (60 mg loading dose) was more likely to cause intracranial bleeding in those with a history of stroke or transient ischemic attack compared to clopidogrel.[21] Thus, the American Heart Association guidelines state that prasugrel should not be given to patients with a history of stroke.[22] Although low-dose prasugrel loading (20 mg) has been reported not to increase the risk of intracranial hemorrhage in emergency endovascular treatment for ICAD,[23] it is not currently approved for acute ischemic stroke in Japan, and further safety verification is needed. *CYP2C19* genotype-guided antiplatelet therapy following PCI is effective for acute coronary syndrome.[24] A case report highlighted the potential for personalized antiplatelet therapy based on genomic information during neuro-endovascular treatment,[25] indicating a shift toward tailored treatment strategies, including rapid genotyping during emergency endovascular procedures for ICAD. Ozagrel sodium is the only intravenous antiplatelet agent available in Japan for ischemic stroke and is often used in the treatment of ICAD in combination with oral antiplatelet agents such as aspirin and clopidogrel,[15,23] but it is important to note that it does not provide comprehensive information on efficacy or safety profile specific to ICAD. Additional studies will be needed to establish the efficacy of ozagrel sodium in the treatment of ICAD. Despite not being approved in Japan, administering intravenous tirofiban, a selective glycoprotein IIb/IIIa receptor inhibitor, during emergency endovascular therapy for ICAD-LVO has been found to decrease the number of passes and improve the likelihood of favorable outcomes without causing an increase in bleeding complications.[26] Some antithrombotic agents are not approved in Japan for emergency endovascular therapy of ICAD, indicating the need for additional research and development.

Conclusion

SR angioplasty is a safe and effective procedure for treating MCA M2 segment occlusion underlying ICAD.

Ethical Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and national research committees and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for the publication of this case report and accompanying images.

Disclosure Statement

Hirotoshi Imamura has received the speakers' presentation honorarium/speaking fee from Medtronic, DAIICHI SANKYO COMPANY, Johnson & Johnson, Stryker, Terumo, and ASAHI INTECC. All the other authors report no disclosures relevant to the manuscript.

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