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Case Report

Subacute In-Stent Occlusion 2 Weeks after CASPER Rx Stenting: A Case Report

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Objective: CASPER Rx stent (Terumo, Tokyo, Japan) is one of the dual-layer micromesh stents for carotid artery stenosis. Although it is expected to be safe and efficacious even for vulnerable plaque, we report a case of in-stent occlusion 2 weeks after stenting with CASPER Rx stent.

Case Presentation: The patient was a 78-year-old man with a symptomatic, severely stenosed lesion of the cervical internal carotid artery (ICA). He had an unstable plaque and underwent carotid artery stenting with the CASPER Rx stent. There were no problems with the procedure or the patient's subsequent course, and he was discharged home 1 week after the procedure. However, on postoperative day 14, the patient had a transit ischemic attack and imaging showed acute occlusion due to thrombus in the stent and in the distal part of the ICA. Mechanical thrombectomy was performed and good recanalization was achieved, but postoperative cerebral infarction was observed and the patient was transferred to other hospital with modified Rankin Scale 2.

Conclusion: We experienced a case of in-stent occlusion 2 weeks after stenting with the CASPER Rx stent.

Keywords carotid artery stenting, CASPER Rx stent, subacute occlusion

Introduction

Kotsugi et al. reported plaque protrusion (PP) as one of risk factors strongly associated with ischemic complication during carotid artery stenting (CAS).[1] New stents such as the CASPER stent (Terumo Corp., Tokyo, Japan), a double-layer micromesh stent, have been clinically applied, and a lower ischemic complication rate compared with that of conventional stents has been reported from several clinical studies.[2,3] Such results suggest that a low ischemic stroke rate is associated with prevention of PP. In the Japanese clinical trial on which the CASPER Rx stent is based, the CASPER Rx stent was successfully implanted in 99.3% of cases, and the postinterventional cerebral infarction rate was 1.4%, all of which were complications on the day of stenting or the first postinterventional day.[3] In another literature, four transit ischemic attacks were reported after day 2 of stenting.[3] In-stent revascularization was required in 2.4% of cases, either in the acute phase, the day after stenting, or in the chronic phase, 180–365 days after stenting.[3] In the present study, we report a case of in-stent occlusion complication in the subacute phase 2 weeks after stenting of the CASPER Rx stent, in which mechanical thrombectomy was performed and recanalization was achieved.

Case Presentation

The case is a 78-year-old man. He was originally independent and had a history of diabetes, myocardial infarction, and multiple myeloma. His multiple myeloma was in remission. He suddenly developed aphasia and disorientation, which improved spontaneously within 2 hours, but close examination revealed cerebral infarction in the left insular gyrus and left watershed area, and a highly stenotic lesion in the left cervical internal carotid artery (ICA) bifurcation (**Fig. 1**). Cervical MRI plaque imaging showed vulnerable plaques (**Fig. 2**). Resting state ^{123}I-IMP (Nihon Medi-Physics, Tokyo, Japan) single-photon emission CT showed no obvious difference between the left and right sides. In accordance with

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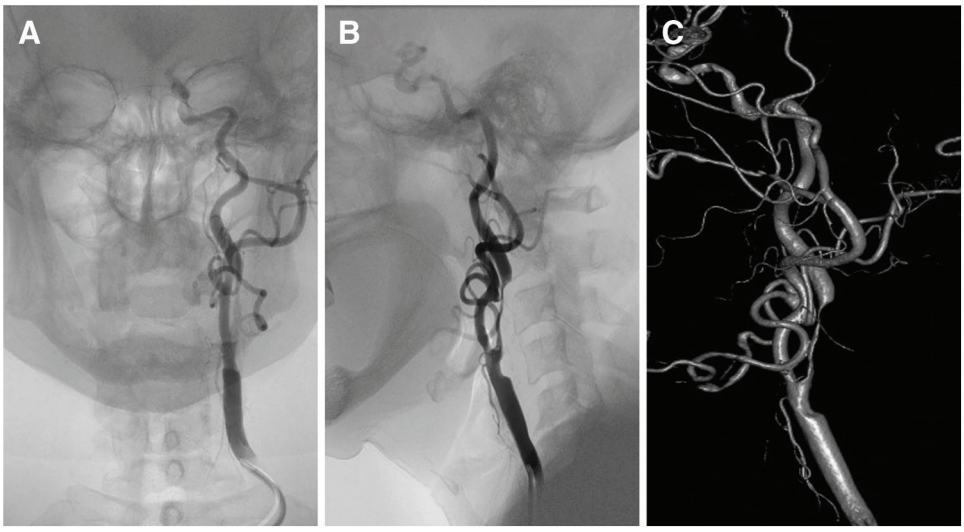

Fig. 1 Preoperative left cervical angiogram: AP view (**A**), LAT view (**B**), and 3D-DSA (**C**). The lesion was elevated at the level of the second through fourth vertebral bodies, with a lesion length of approximately 4 cm and an NACET 76%. The diameter of the common carotid artery, the narrowest part of the lesion, and the ICA was 6.93 mm, 1.33 mm, and 5.53 mm, respectively. AP: anteroposterior; ICA: internal carotid artery; LAT: lateral; NACET: North American Symptomatic Carotid Endarterectomy Trial

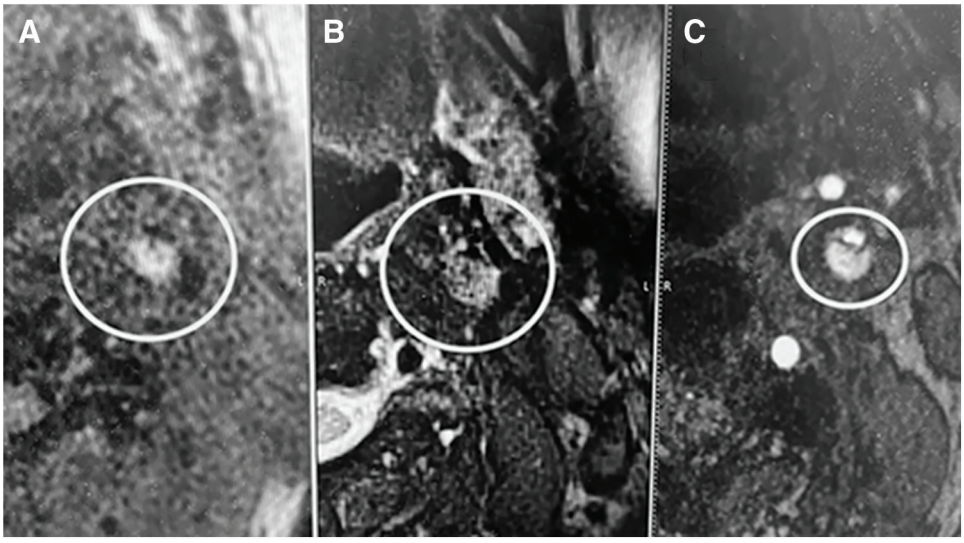

Fig. 2 Left cervical MRI plaque axial imaging: T1 (**A**), T2 (**B**), and TOF (**C**). Unstable plaque including intraplaque hemorrhage with T1 high intensity (**A**), T2 high intensity (**B**), and TOF high intensity (**C**), and plaque muscle ratio 3.13 were observed. TOF: time of flight

the patient's wishes, a CAS with the CASPER Rx stent was planned. The patient was heparinized with a target activated clotting time (ACT) >275 s under general anesthesia. The left common carotid artery was occluded with a balloon guiding catheter and the left external carotid artery was also occluded with a balloon to create a reverse flow model. An Rx-Genity 3.0 mm × 40 mm (Kaneka Medics, Osaka, Japan) was used for pre percutaneous transluminal angioplasty (PTA) dilatation of 8 atm for 30 s. The CASPER Rx stent 8 mm × 40 mm was then passed around the most stenotic area and deployed. Due to insufficient dilatation, an Rx-Genity 4.0 mm × 40 mm was used for post-PTA dilatation. However, when PTA was applied up to 4 atm, the patient became hypotensive and bradycardic, so it was stopped. Post-PTA dilatation was performed again with vasopressors, but it was discontinued due to the same hypotension and bradycardia. The reverse flow model was removed and it was confirmed that there were no apparent adverse events. Compared with the preoperative period, the intracranial flow delay also appeared to have improved, and the operation was

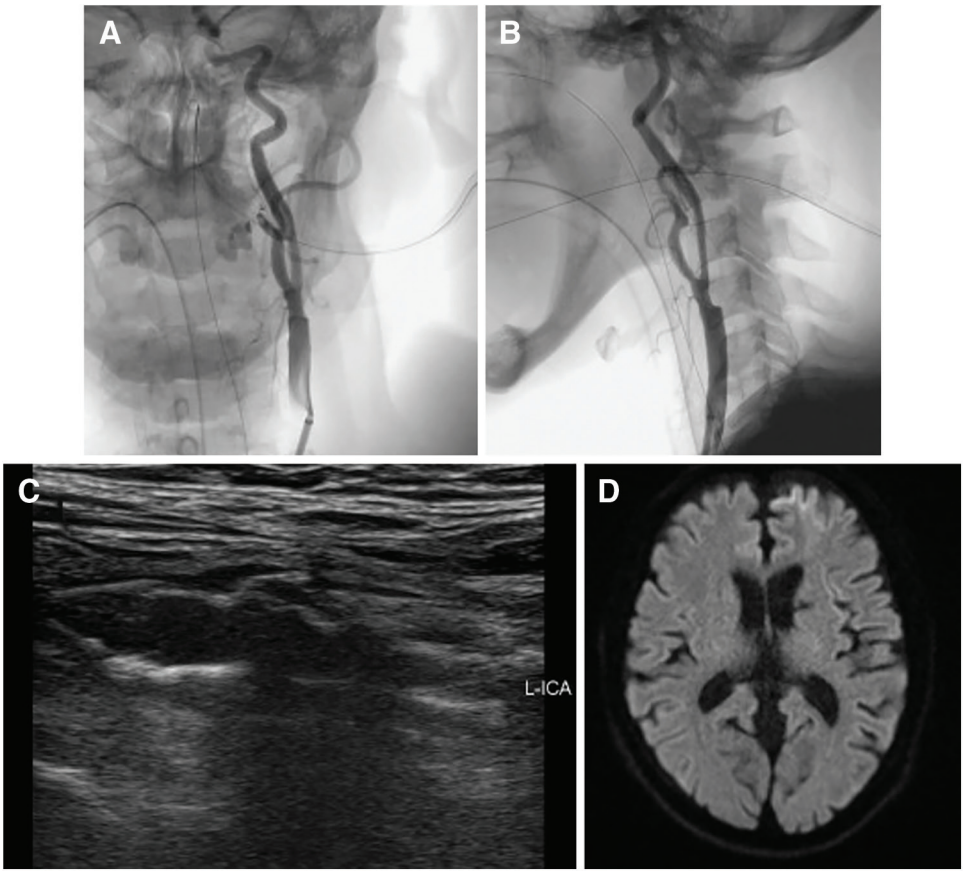

Fig. 3 Postoperative imaging: left cervical angiogram AP view (**A**), LAT view (**B**), ultrasonogram (**C**), and head MRI (DWI) (**D**). Improvement of the stenosis was observed. No obvious PP or in-stent thrombus was observed. No obvious cerebral infarction was observed. AP: anteroposterior; DWI: diffusion-weighted imaging; LAT: lateral; PP: plaque protrusion

finished (**Fig. 3**). Postoperative intravascular ultrasound (IVUS) was not performed, but carotid ultrasound was performed on postoperative day 3 and there was no obvious PP or in-stent thrombus (**Fig. 3**). There were no significant complications and the patient was discharged home 1 week postoperatively with a modified Rankin Scale (mRS) score 1 under the double antiplatelet therapy (DAPT). However, on postoperative day 14, muscle weakness in the right upper and lower limbs and dysarthria were observed, and imaging showed that the left ICA was poorly visualized from the cervical bifurcation (**Fig. 4**). Urgent mechanical thrombectomy was performed on the same day. Thrombectomy was performed mainly by thrombus aspiration with EMBOVAC (Cerenovus, Tokyo, Japan). Only a small amount of thrombus was found inside the stent. Because a thrombus remained in the cavernous sinus portion of the ICA, thrombus aspiration was performed in the same way, but thrombectomy was difficult. Therefore, we used a combined technique with EMBOTRAP III 6.5 mm × 45 mm (Cerenovus) and EMBOVAC to retrieve the thrombus, and recanalization was achieved with thrombolysis in cerebral infarction 3. However, restenosis was observed in the stent, so an Rx-Genity 4.5 mm × 30 mm was used for PTA dilatation with a distal protection FilterWire EZ 190 cm. The patient also became hypotensive and bradycardic with this PTA dilatation, but it was transient and did not persist for more than 24 hours. After that, restenosis improved (**Fig. 5**). Postoperatively, scattered cerebral infarctions were observed in the left frontal cortex and deep white matter (**Fig. 6**), and the patient remained symptomatic and was hospitalized with an mRS score 2.

Discussion

To evaluate the clinical outcome of treatment and safety of dual-layer, self-expanding carotid stents in patients with carotid artery stenosis and risk factors for carotid endarterectomy, a prospective, multinational, single-arm, physician-initiated study was conducted in Belgium, Italy, and Germany.[4] All patients were successfully stented. The

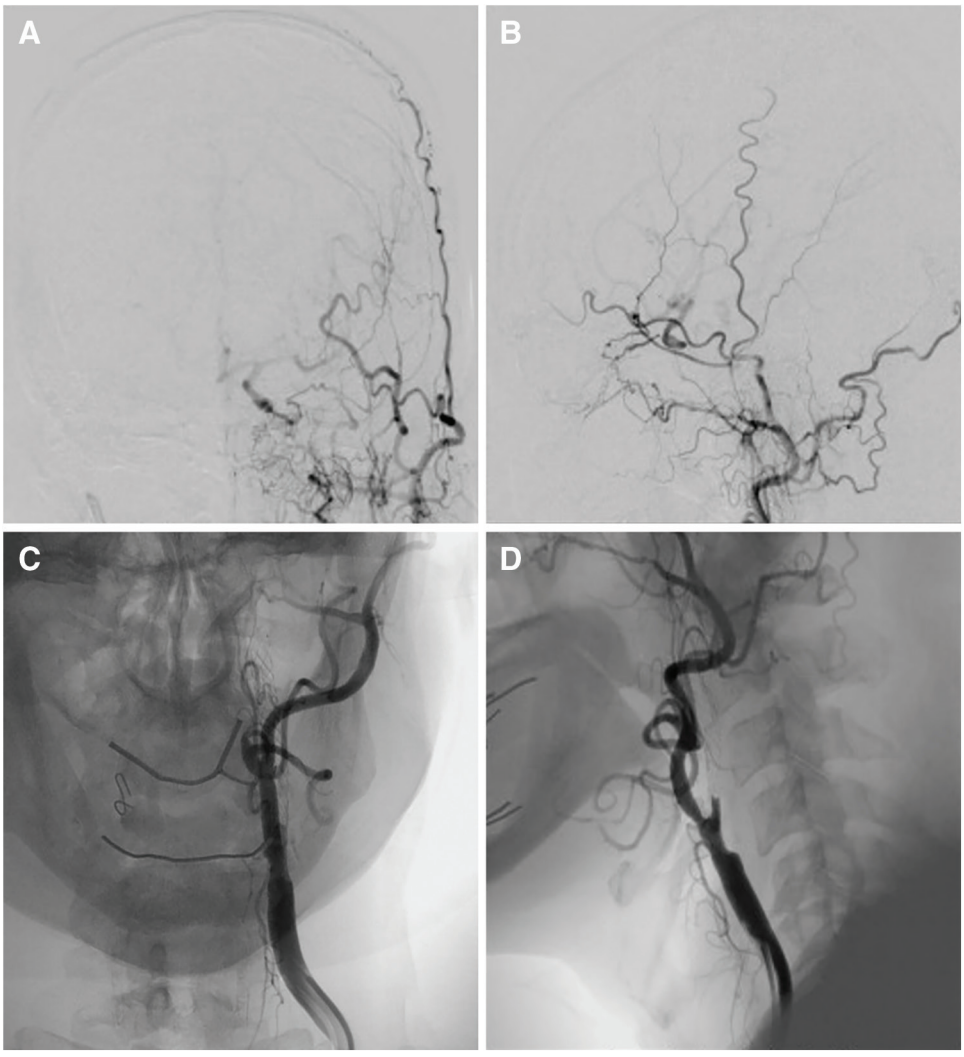

Fig. 4 Left angiogram 2 weeks after stenting: internal cerebral AP view (**A**), LAT view (**B**), cervical AP view (**C**), and LAT view (**D**). The patient had a left ICA occlusion from the proximal portion of the stent. However, retrograde blood flow was observed from the ophthalmic artery via a recurrent meningeal artery. AP: anteroposterior; ICA: internal carotid artery; LAT: lateral

study showed that ipsilateral stroke-free rate within 12 months of stenting was 95.8% and death, stroke, or myocardial infarction rate within 30 days of stenting was 2.1%.[4] Based on national and international reports, the efficacy and safety of this stent, which has an interwoven structure, are assured. In-stent thrombus after CAS is often associated with an unfavorable prognosis if it leads to occlusion of the ICA.[5] In the present meta-analysis, this particular aspect was separately evaluated. The rate of dual-layer stent occlusion is 0.8% in a total of 930 patients.[6] It seems to be similar to the results reported by Moulakakis et al.[7] They described a series of 674 CAS with standard stents, having four cases (0.6%) of acute thrombosis. All of these were occlusions that occurred within 4 days of stenting. Huibers et al. reported that in 761 CAS cases, ischemic strokes occurred in 76.4% within 24 h after the procedure, and in 12.7%, between day 1 and day 7 after the procedure.[8] Most cases of in-stent thrombosis occur within the first week of treatment and are often resolved with conservative management or a single additional endovascular procedure.[9] Reports of subacute obstructive complications more than 1 week after implantation are extremely rare and remain at the case report.[10] In particular, this is the first report of a subacute obstructive complication with a CASPER Rx stent. In this case, his multiple myeloma was in remission and it was unlikely to be a condition that would lead to an embolization procedure. DAPT was started 20 days prior to surgery and continued postoperatively. We used Hematracer 912 (DS Medical, Tokyo, Japan) to determine the drug effect of aspirin and

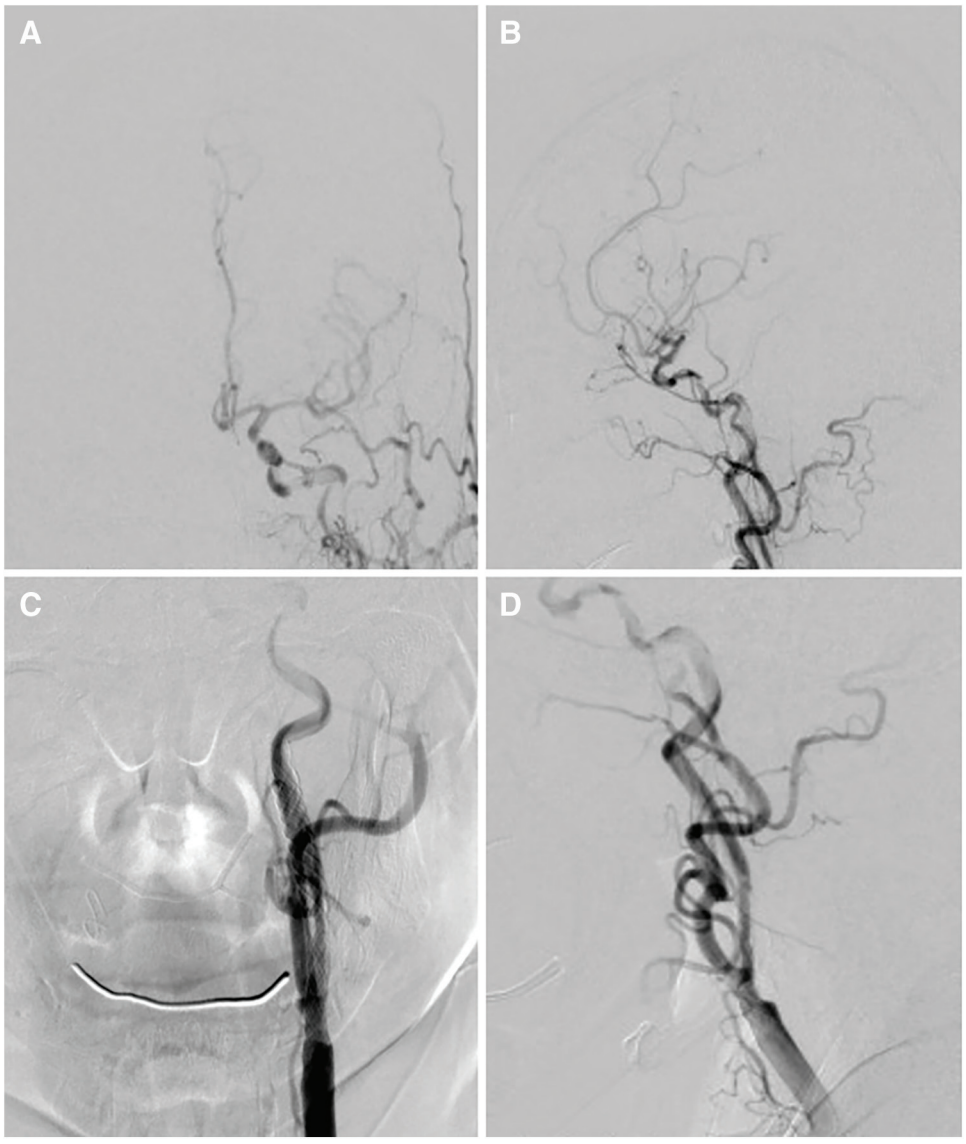

Fig. 5 Left internal cerebral angiogram after mechanical thrombectomy: internal cerebral AP view (**A**), LAT view (**B**), cervical AP view (**C**), and LAT view (**D**). Effective recanalization was obtained. AP: anteroposterior; LAT: lateral

clopidogrel using the light transmission platelet aggregation test. This platelet aggregation test confirmed resistance to clopidogrel. Therefore, two drugs, aspirin and cilostazol, were used. After placement of the CASPER Rx stent, the patient was deemed to have inadequate dilatation and was scheduled to undergo a full post-PTA dilatation. However due to hypotension and bradycardia associated with the post-PTA dilatation, it had to be discontinued in the middle of the procedure. Compared to the preoperative period, adequate dilation had been achieved, and the operation was finished. Mechanical thrombectomy revealed a small amount of white in-stent thrombus. PP was also considered for in-stent restenosis, but no additional stenting was performed as there was no restenosis after re-dilatation. The cavernous sinus portion of the ICA was highly calcified and the thrombus was very solid. Although it is difficult to determine the cause of the ICA occlusion in this case, it was speculated that after stenting, a small and delayed PP occurred in the stent. It caused thrombosis in the stent, or it migrated distally and became trapped in a highly calcified lesion, causing further thrombosis. With regard to the timing of onset of PP, various timings of onset of postoperative PP have been reported, such as within a week or within 1 to 4 weeks.[11,12] In this case, the carotid ultrasound on postoperative day 3 showed no PP, so it is possible that delayed PP developed between 4 and 14 days

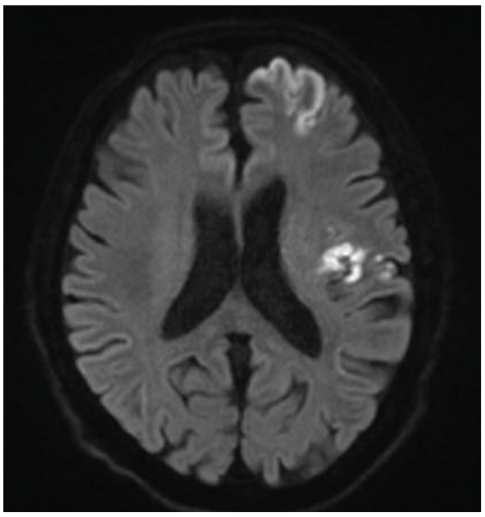

Fig. 6 Head MRI (DWI) after mechanical thrombectomy. Scattered cerebral infarctions were observed in the left frontal cortex and deep white matter. DWI: diffusion-weighted imaging

postoperatively, leading to the stroke on postoperative day 14. Since delayed PP cannot be detected by IVUS immediately after stenting, the way to detect it early is frequent evaluation with postoperative CTA and carotid ultrasound. There is no established treatment for delayed PP after CAS, but if early detection is made, enhanced antiplatelet and anticoagulation therapy and additional stenting are possible treatment options. Otherwise, inadequate antiplatelet efficacy of aspirin and cilostazol may have led to in-stent thrombosis without PP. Virchow's triad explains the major factors that lead to stent thrombosis.[13] First, stasis and turbulence caused by an under-expanded stent, a stent in a small vessel, or a long lesion. Second, injury or endothelial disruption caused by edge dissection or delayed healing with eluting drug stents. Finally, hypercoagulability was congenital or acquired or nonresponder.[14] The patient had inadequate post-PTA dilatation after stenting and a long lesion length that could easily cause thrombosis. Therefore, additional prasugrel may have prevented the ICA occlusion. Further post-PTA dilation with additional vasopressors may also be considered.

Conclusion

We experienced a case of in-stent occlusion 2 weeks after stenting with the CASPER Rx stent.

Acknowledgments

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Disclosure Statement

All authors declare that they have no conflicts of interest associated with this manuscript. The manuscript has not been published previously and is not under consideration for publication elsewhere.

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