CASE REPORT

Delayed ischemic stroke due to stent marker band occlusion after stent-assisted coiling

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SUMMARY

A middle-aged patient with an internal carotid-posterior communicating artery aneurysm and basilar artery tip aneurysm was treated by stent-assisted coiling. One ischemic infarction and two transient ischemic attacks occurred with the same symptoms (inability to walk unassisted and tendency to fall to the left) during the first 2 years post-treatment. The ischemic infarction was found in the right side of the pons, consistent with the vascular territory of the stent-containing vessel. The cause of the delayed ischemic stroke was investigated on DSA and cone beam CT, which revealed that the proximal end of the stent, one marker band, was just covering a small perforating artery of the basilar artery trunk. The present case suggests that marker band occlusion can induce delayed ischemic stroke. To prevent this complication, it is important to evaluate the perforating vessels preoperatively and carefully deploy a stent for the marker band to avoid occlusion of large perforating vessels. Post-treatment evaluation is also important because dual antiplatelet therapy will be required for a longer period if an artery is occluded by a marker band.

BACKGROUND

Stent-assisted coiling (SAC) is a common technique for complex aneurysms with a broad neck or low dome-neck ratio. However, the risk of delayed ischemic stroke in patients treated with stent-assisted coil embolization is well known.¹⁻³ Generally, delayed ischemic stroke is caused by an embolism from the stent or thrombotic occlusion of the stent-containing vessels because of inadequate stent strut apposition, a short period of dual antiplatelet therapy (DAPT), or a residual sac.^{1,2}

We experienced a rare case in which a marker band at the proximal end of the stent occluded a small perforating artery of the basilar artery (BA) trunk, resulting in delayed ischemic stroke.

CASE PRESENTATION

History and treatment

A middle-aged patient was incidentally found to have two aneurysms. MR angiography (MRA) demonstrated an internal carotid-posterior communicating artery (IC-PC) aneurysm and a BA-tip aneurysm, and DSA and three-dimensional rotational angiography confirmed that the sizes of these aneurysms were 5.2 mm with 4.8 mm neck and 4.2 mm with 4.0 mm neck, respectively (figure 1A). The patient received DAPT (clopidogrel 75 mg and

aspirin 100 mg) before the procedure. The response to the antiplatelet agents was adequate according to the VerifyNow Assay (Accumetrics, San Diego, California, USA): 387 aspirin response units and 160 P2Y12 receptor reaction units (inhibition 15%). The IC-PC aneurysm was treated by endovascular therapy; 3 months later, the BA-tip aneurysm was not treated by direct or balloon-assisted coil embolization but by SAC because of a low dome-neck ratio. A Neuroform stent (Stryker, Kalamazoo, Michigan, USA) was deployed from the right posterior cerebral artery to the BA trunk. Cone beam CT (CBCT) was subsequently performed and demonstrated adequate stent apposition to the vessel wall with coverage of the necks of the aneurysms.

Post-treatment course

The 9-month post-treatment DSA showed that the two aneurysms were completely occluded and that the stent-containing vessels were patent (figure 1B). We switched the patient to only aspirin 100 mg. One month after this treatment reduction, the patient was unable to walk without assistance and tended to fall to the left side despite the absence of motor weakness and sensory loss of the limb. MRI showed that an ischemic stroke had occurred in the right side of the pons, consistent with the vascular territory of the stent-containing vessel (figure 2). DSA demonstrated that the BA-tip aneurysm was completely occluded, and no thrombosis was present in the stent. Echocardiography and other imaging techniques for ischemic stroke were performed; however, the cause of the ischemic stroke was unclear. We switched to DAPT as a precaution, and the patient recovered with a modified Rankin scale score of 0 at discharge. Eleven months later, we switched the patient to aspirin 100 mg and clopidogrel 25 mg. Three months after this treatment reduction, a transient ischemic attack (TIA) with the same symptom occurred, but the cause of the TIA was also unclear. The 2-year follow-up MRA showed that the aneurysms were completely occluded, and we switched to only clopidogrel 75 mg. Eighteen days after this treatment reduction, the TIA recurred with the same symptom. The response to clopidogrel was adequate: 169 P2Y12 receptor reaction units (inhibition 22%). The cause of the TIA was investigated on DSA and CBCT, which revealed that one marker band at the proximal end of the stent was covering a small perforating artery arising from the BA trunk.

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Figure 1 (A and B) Three-dimensional rotational angiography, anteroposterior view and working angle view, showing the basilar tip aneurysm with low dome-neck ratio. (C) DSA, anteroposterior view, showing the basilar artery tip aneurysm before treatment. (D) DSA immediately after treatment showing complete occlusion of the basilar artery tip aneurysm.

In retrospect, the perforating artery was initially covered with the marker band (figure 3).

DISCUSSION

We experienced a rare case in which a stent marker band occluded a perforating artery. One delayed ischemic infarction and two transient ischemic attacks occurred after treatment. Generally, delayed ischemic stroke is caused by an embolism from the stent or thrombotic occlusion of the stent-containing vessels because of inadequate stent strut apposition, a short period of DAPT,

Figure 2 Diffusion-weighted MRI showing that an ischemic stroke had occurred in the right side of the pons, consistent with the vascular territory of the stent-containing vessel.

Figure 3 (A) DSA 2 years after treatment showing complete occlusion of the basilar artery tip aneurysm and no thrombosis in the stent. Note the stent marker band (arrow) and small perforating vessel (arrowhead) from the basilar trunk. (B) Coronal view. Cone beam CT demonstrating adequate stent apposition to the vessel wall; the proximal end of the stent (arrow) is just covering a small perforating artery (arrowhead). (C) Axial view. At the proximal end of the stent, one marker band (arrow) was just covering a small perforating artery (arrowhead). (D) DSA after initial placement of the stent showing that the positional relationship between the marker band (arrow) and the small perforating vessel (arrowhead) has not been changed for 2 years compared with A.

or a residual sac.^{1 2} To our knowledge, this is the first report of delayed ischemic stroke due to stent marker band occlusion.

The optimal duration of DAPT for prevention of delayed ischemic stroke remains unclear. In a large retrospective study, DAPT for more than 9 months and a late switch to monotherapy were recommended for prevention of delayed ischemic stroke, and SAC-associated delayed ischemic stroke occurred after switching from DAPT.² In another study, discontinuation of clopidogrel may have been associated with a risk of ischemic events in patients treated with SAC.³ In the present case, the duration of DAPT was appropriately long compared with that in previous reports, and ischemic stroke occurred despite clopidogrel therapy.¹⁻³ Furthermore, all delayed ischemic strokes occurred within 3 months after switching from DAPT and manifested with the same symptom. Thus, the cause of all three delayed ischemic strokes was considered to be the same. DSA and CBCT showed that although the stent strut was deployed adequately and the aneurysm was occluded completely, one marker band at the proximal end of the stent was covering a small perforating artery arising from the BA trunk. The onset of the delayed ischemic stroke was strongly associated with the stent marker band in the affected vascular territory.

Many reports have described the efficacy and safety of SAC.^{4 5} SAC has become a common technique in the treatment of aneurysms, including BA aneurysms. In terms of the effects of intracranial stents, a stent strut can have a considerable influence on the flow in the affected perforating vessels

near the treated cerebral aneurysms.^{6,7} When using a flow diverter stent with high surface coverage and low porosity, delayed ischemic stroke may occur due to perforating ischemia.⁷ Perforating vessels covered by conventional intracranial stent struts are usually patent; however, a marker band is larger than a stent strut and can be a risk factor for decreased flow in the same way as a flow diverter stent; ischemic stroke could be induced when the marker band is covered with a small perforating artery.

Many small perforating vessels of the BA are reportedly present, ranging in diameter from 80 to 940 μm .⁸ Some of these perforating vessels cannot be visualized well on conventional DSA. In the present case, CBCT showed that one marker band was just covering a small perforating artery, and the patient's clinical course suggests that marker band occlusion can induce delayed ischemic stroke. To prevent this complication, it is important to thoroughly evaluate the perforating artery preoperatively and carefully deploy a stent for the marker band to avoid occlusion of major perforating vessels. Certainly, it would be difficult to assess and avoid all perforators, but at least large perforating vessels should be avoided. Moreover,

post-treatment evaluation is important because DAPT will be required for a longer period if an artery is occluded by a marker band.

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Competing interests None declared.

Patient consent Detail has been removed from this case description/these case descriptions to ensure anonymity. The editors and reviewers have seen the detailed information available and are satisfied that the information backs up the case the authors are making.

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Learning points

- Stent marker band occlusion can induce delayed ischemic stroke.
- It is important to evaluate the perforating artery preoperatively.
- Attention should be given to deployment of a stent for the marker band to at least avoid occlusion of large perforating vessels.
- Dual antiplatelet therapy is required for a longer period if a perforating artery is occluded by a marker band.

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