CASE REPORT

Very late stent thrombosis following the placement of a crossing Y-stent with dual closed-cell stents for the coiling of a wide-necked aneurysm

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SUMMARY

The crossing Y-stent technique is a viable option for coiling of wide-necked bifurcation aneurysms. However, little is known about the long-term impact of this technique. Very late (>1 year) stent thrombosis following the placement of a crossing Y-stent with dual closed-cell stents for the coiling of a wide-necked basilar tip aneurysm, which has not been reported to date, is described.

BACKGROUND

The treatment of wide-necked bifurcation aneurysms, particularly those located at the basilar tip, is challenging for neurosurgeons. The crossing Y-stent technique, which involves passing one stent through the interstices of the other to form a 'Y', has been reported to be a useful option in the

endovascular coiling of these aneurysms.^{1–4} A number of case reports and small series have reported the technical feasibility of this approach with promising early results.^{1 2 4} However, few data exist regarding the impact on the cerebrovasculature of crossing dual stents. We report a case of very late stent thrombosis (VLST), defined in the coronary literature⁵ as stent thrombosis occurring beyond 1 year after implantation, which developed in the crossing Y-stent using dual closed-cell stents, which has not previously been reported in the literature.

CASE PRESENTATION

Stent-assisted coiling was performed for a 7.5×6.0 mm unruptured basilar tip aneurysm with a wide neck of 5.5 mm incorporating both posterior cerebral arteries (PCAs; figure 1A). The

Figure 1 (A) Right vertebral three-dimensional rotational angiogram showing a wide-necked basilar tip aneurysm incorporating the origins of both posterior cerebral arteries (PCAs). (B) Anteroposterior right vertebral artery angiogram showing successful deployment of the initial Enterprise stent from the right P1 to the proximal basilar artery (arrow indicates the proximal stent markers). (C) A second Enterprise stent was successfully deployed through the interstices of the initial stent from left P1 to the mid basilar artery in a Y-configuration (short arrows point to the proximal and distal markers of the second stent). (D) Angiographic flat-panel CT demonstrating the Y-configuration of the dual stents, with the distal end of each Enterprise stent in the PCA and the proximal ends telescoped within one another in the mid basilar artery. (E) The aneurysm was completely obliterated with coils with preservation of both PCAs.

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Figure 2 (A) Angiography at 1 year follow-up showing persistent complete obliteration of the aneurysm with both posterior cerebral arteries (PCAs) patent and no evidence of in-stent stenosis. (B) Diffusion-weighted imaging obtained after the development of symptoms of ischemia showed an acute infarction in the bilateral thalamus, left occipital lobe and left superior cerebellum. (C) An urgently performed angiogram demonstrated total occlusion of the left PCA, left superior cerebellar artery and basilar apex secondary to the stent thrombosis (arrow indicates thrombus within the stent placed in the right P1). (D) Reopening of the basilar apex and both PCAs was achieved by emergency intra-arterial thrombolysis, but a small thrombus remained at the intersection of both stents (short arrow).

procedure was performed using full anticoagulation with intravenous heparin (activated clotting time >250 s). No atherosclerotic stenosis was found in the basilar artery or the PCAs. First, a closed-cell Enterprise stent (4.5×28 mm; Cordis, Miami Lakes, Florida, USA) was navigated in the right PCA and implanted from the right PCA to the mid basilar artery (figure 1B). Coiling using bare platinum coils (Orbit; Cordis) was performed, but failed due to herniation of the loops of the first coil into the left PCA. Another Enterprise stent (4.5×22 mm) was therefore navigated through the interstices of the initially deployed stent into the left PCA and subsequently deployed without difficulty (figure 1C). The aneurysm was then completely obliterated without compromising blood flow through either PCA (figure 1D). The patient had an uneventful postoperative course and was maintained on dual antiplatelet medication for 1 year post-operatively. One-year follow-up angiography showed persistent

complete obliteration of the aneurysm with both PCAs patent and no evidence of in-stent stenosis (figure 2A). The patient was recommended to remain on a single 100 mg daily dose of aspirin. One month later the patient experienced blurred vision, perioral numbness and headaches, indicating a possible transient ischemic attack. Her antiplatelet medication was changed from aspirin monotherapy to dual antiplatelet therapy (100 mg aspirin and 75 mg clopidogrel daily). At 20 months after initial treatment, the patient presented to the emergency department with altered mentality and right arm weakness. During investigation of her medical history, the patient revealed that she had voluntarily stopped taking her antiplatelet medication prior to a colonoscopy examination 5 days before the event. Diffusion-weighted images showed acute infarction in the bilateral thalamus, left occipital lobe and left superior cerebellum (figure 2B). Conventional angiography demonstrated thrombosis

Figure 3 Digital image of the two crossing Enterprise stents deployed in a Y-configuration in vitro. Note the collapsed floating struts (arrow) of the second stent due to the fixed cell of the initial stent at the intersection of the two stents.

in stents, resulting in complete occlusion of the left PCA, the left superior cerebellar artery and the upper basilar artery (figure 2C). Intra-arterial thrombolysis with urokinase was immediately performed, resulting in the reopening of the basilar artery and both PCAs (figure 2D). After successful recanalization, the patient regained consciousness but exhibited agitated aggressive behavior and mild residual right hemiparesis. Six months after thrombolysis the patient was much improved and was maintained on dual antiplatelet therapy.

DISCUSSION

Stent-assisted coiling has been associated with ischemic events due to stent thrombosis.⁶ Recent studies have reported an approximate rate of thrombosis of 4.5–8.7%.⁶ Most of these thromboses occurred acutely or subacutely during the first month after treatment.^{1 4 6} The occurrence of thrombosis beyond 3 months after stenting is rare, probably because stent endothelialization is completed by 3–6 months.⁷ Dual antiplatelet therapy is essential to prevent stent thrombosis.⁸ However, the optimal duration of treatment has not yet been defined and varies widely, ranging in the literature from 4 weeks to 6 months regardless of the complexity and number of stents implanted.^{1 2 4} Some authors tend to recommend dual antiplatelet therapy only for 3 or 6 months after treatment.^{1 2} Such tendencies seem to be based on the fact that the target vessel for stent placement is usually non-atherosclerotic and bare metal

self-expandable stents for coiling assistance are not delaying endothelialization and not causing endothelial injury.

VLST has been reported in the coronary stent literature, although it is rare.⁹ The discontinuation or alteration of antiplatelet therapy, incomplete neointimal coverage of stent struts, drug resistance, progressive in-stent stenosis and the use of drug-eluting stents, for example, have all been proposed as causes of VLST.^{9 10} VLST following crossing Y-stent coiling has not previously been reported. For a crossing Y-stent, two main designs of self-expanding stents (open-cell and closed-cell) have been used randomly in combinations in clinical practice.^{1–4} The advantages of a closed-cell stent over an open-cell stent include the easier navigability through the tortuous intracranial arteries, ease of use and superior scaffolding provided across the neck of aneurysms.³ However, unlike the open-cell stent, the closed-cell stent has a closed fixed cell and is non-segmental because all the struts are connected. Thus, in the case of a crossing Y-stent using dual closed-cell stents, extensive tubular collapse of the second stent may occur at the intersection (figure 3). On the other hand, collapse of the second stent at the crossing point may not occur or occurs less extensively in Y-stent constructs using dual open-cell stents or hybrid combinations, respectively, due to the free cells and independent segments of the open-cell design. The captured floating struts of the second stent may not adhere to the underlying vessel wall and may thus yield a small isolated space between the struts and the underlying vessel wall. The unapposed floating struts are not well endothelialized, so the orphaned space and incompletely apposed stent may remain a potential thrombogenic source for a long time. In the present case, the thrombus in the left PCA and the left side of the upper basilar artery where the second stent was placed was denser than those in the right side. There was no in-stent stenosis on the 1 year follow-up angiography. Given these facts, non-endothelialized stent struts may have caused stent thrombosis after the discontinuation of antiplatelet therapy at 20 months following stent implantation.

Learning points

- ▶ Stent-assisted coiling has been associated with ischemic events due to stent thrombosis.
- ▶ A crossing Y-stent using dual closed-cell stents shows extensive tubular collapse of the second stent at the intersection, which may increase the risk for thromboembolic complications due to poor stent-wall apposition.
- ▶ Use of antiplatelet agents in patients treated by stent-assisted coiling using a crossing Y-stent technique, especially with dual closed-cell stents is needed for a much longer duration than is currently being used for prophylaxis against thrombosis following other stent-assisted techniques.

Contributors Both authors contributed to the interpretation and analysis of the results and writing of the paper.

Competing interests None.

Patient consent Obtained.

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REFERENCES

- 1 Akgul E, Aksungur E, Balli T, *et al*. Y-stent-assisted coil embolization of wide-neck intracranial aneurysms. A single center experience. *Interv Neuroradiol* 2011;17:36–48.
- 2 Lozen A, Manjila S, Rhiew R, *et al*. Y-stent-assisted coil embolization for the management of unruptured cerebral aneurysms: report of six cases. *Acta Neurochir (Wien)* 2009;151:1663–72.
- 3 Rohde S, Bendszus M, Hartmann M, *et al*. Treatment of a wide-necked aneurysm of the anterior cerebral artery using two Enterprise stents in “Y”-configuration stenting technique and coil embolization: a technical note. *Neuroradiology* 2010;52:231–5.
- 4 Spiotta AM, Gupta R, Fiorella D, *et al*. Mid-term results of endovascular coiling of wide-necked aneurysms using double stents in a Y configuration. *Neurosurgery* 2011;69:421–9.
- 5 Cutlip DE, Windecker S, Mehran R, *et al*. Clinical end points in coronary stent trials: a case for standardized definitions. *Circulation* 2007;115:2344–51.
- 6 Kanaan H, Jankowitz B, Aleu A, *et al*. In-stent thrombosis and stenosis after neck-remodeling device-assisted coil embolization of intracranial aneurysms. *Neurosurgery* 2010;67:1523–32; discussion 1532–33.
- 7 Awata M, Kotani J, Uematsu M, *et al*. Serial angioscopic evidence of incomplete neointimal coverage after sirolimus-eluting stent implantation: comparison with bare-metal stents. *Circulation* 2007;116:910–16.
- 8 King SB III, Smith SC Jr, Hirshfeld JW Jr, *et al* 2007 focused update of the ACC/AHA/SCAI 2005 guideline update for percutaneous coronary intervention: a report of the American College of Cardiology/American Heart Association Task Force on Practice guidelines. *J Am Coll Cardiol* 2008;51:172–209.
- 9 Buchanan GL, Basavarajaiah S, Chieffo A. Stent thrombosis: incidence, predictors and new technologies. *Thrombosis* 2012;2012:956962.
- 10 Cook S, Wenaweser P, Togni M, *et al*. Incomplete stent apposition and very late stent thrombosis after drug-eluting stent implantation. *Circulation* 2007;115:2426–34.

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