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Case Report

Good neointimal coverage of a crushed stent segment protruding into the main vessel by follow-up optical coherence tomography in a patient with a diagonal branch lesion

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ABSTRACT

There is currently no consensus regarding the optimum treatment strategy for an isolated side branch lesion. The usefulness of a side branch stenting technique with a balloon crushing the segment protruding into the main vessel has been reported; however, there remain concerns about malapposition of crushed stent struts and a consequent risk of stent thrombosis. We herein report a case with a diagonal branch lesion that was successfully treated with this technique. Follow-up optical coherence tomography clearly revealed that the protruding stent struts in the main vessel were crushed and covered almost completely. Our findings may support the feasibility of this treatment in the mid-term period.
<**Learning objective:** There is currently no consensus regarding the optimum treatment strategy for an isolated side branch lesion. In the present case, we successfully treated an isolated diagonal branch lesion using a side branch stenting technique with a balloon crushing the segment protruding into the main vessel. Good neointimal coverage of a crushed stent segment protruding into the main vessel by follow-up optical coherence tomography may support the feasibility of this treatment in the mid-term period.>

Introduction

There is currently no consensus regarding the optimum treatment strategy for an isolated side branch lesion classified as 0,0,1 according to the Medina classification. A new technique was introduced for treating 0,0,1 lesions that was similar to the double-kissing crush technique without main vessel stenting [1], and we have validated the usefulness of this technique in clinical practice [2]. However, there remain concerns about malapposition of crushed stent struts and a consequent risk of stent thrombosis.

We herein report the follow-up images of optical coherence tomography in a case treated with the novel technique for a diagonal branch lesion.

Case report

An asymptomatic 48-year-old man was referred to our hospital because of cardiomegaly detected on chest X-ray. His risk factors were dyslipidemia, a family history of coronary disease, and smoking. The echocardiography revealed diffuse severe hypokinesis with a dilated left atrium and ventricle. Coronary computed tomography angiography showed three-vessel disease, and cardiac scintigraphy demonstrated myocardial ischemia in the corresponding area. After admission to our hospital, the coronary angiogram showed significant stenosis in the proximal and mid-right coronary artery, the diagonal branch, and the mid circumflex artery, so two drug-eluting stents were deployed in the right coronary artery. At the second admission, we implanted a drug-eluting stent in the left circumflex artery and started to treat the diagonal branch lesion using the novel technique (Fig. 1A).

We inserted floppy wires into the main branch and diagonal branch of the left anterior descending artery. Intravascular ultrasonography revealed that the vessel diameter of the ostium of diagonal branch was 2.47×2.72 mm and that the lumen diameter of the left anterior descending artery just proximal to the bifurcation of the diagonal branch was 3.84×4.29 mm. After pre-dilation with a 2.0-mm scoring balloon (Scoreflex; Orbus-Neich, Hong Kong), we deployed a 2.25×32-mm drug-eluting stent (Synergy; Boston Scientific, Boston, MA, USA) in the diagonal branch with a few millimeters of protrusion into the main vessel (Fig. 1B). A 4.0-mm non-compliant balloon in the main vessel

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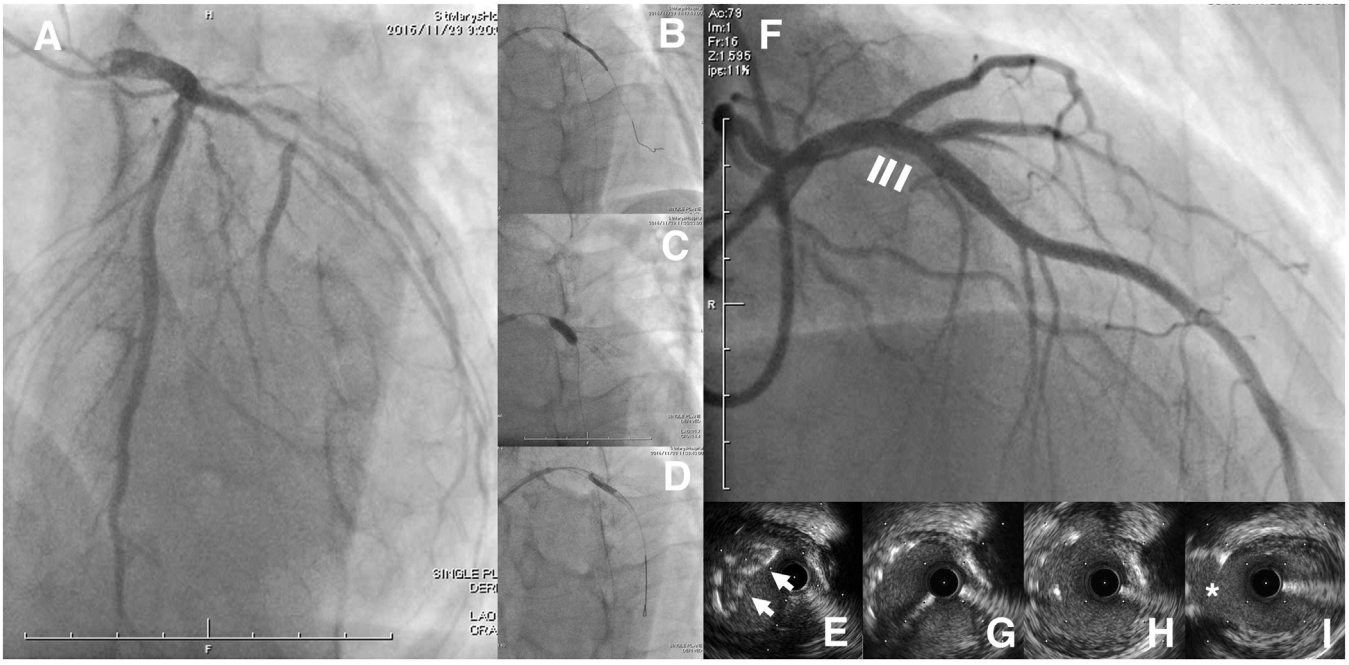

Fig. 1. Left coronary angiography at the left anterior oblique-cranial view showed the diagonal branch lesion (A). We deployed a drug-eluting stent (Synergy; Boston Scientific, Boston, MA, USA) with proximal protrusion into the main vessel (B) and crushed the protruding segment with a balloon in the main vessel (C). After re-wiring, we dilated the ostium of the diagonal branch (D). However, intravascular ultrasonography showed the incomplete apposition of the crushed struts (arrows) (E), we dilated a bigger balloon in the main vessel. The final results on angiography in the right anterior oblique-cranial view were good (F). The bars indicate the position of intravascular ultrasonography, and G–I were assigned from the proximal to the distal sites. Intravascular ultrasonography in the main vessel showed that the stent struts had been completely crushed and were apposed to the vessel wall (G–I). The asterisk indicates the diagonal branch.

which had been inserted before the deployment was inflated to crush the protruding segment of the stent (Fig. 1C). After re-wiring through the side cell, the ostium of the diagonal branch was dilated with the 2.0-mm scoring balloon (Fig. 1D). Because intravascular ultrasonography showed that the crushed struts were incompletely apposed to the vessel wall (Fig. 1E), we dilated a 4.5-mm non-compliant balloon in the main vessel. Subsequent intravascular ultrasonography showed that the strut apposition was complete, and the final angiogram was good (Fig. 1F–I).

Although he remained asymptomatic with dual antiplatelet therapy, the 14-month follow-up coronary angiogram showed severe restenosis in the distal edge of the stent in the diagonal branch (Fig. 2). Interestingly, optical coherence tomography clearly revealed that the protruding stent struts in the main vessel had been crushed and covered almost completely (Fig. 2A–C; Video 1), while the ostial lesion was patent (Fig. 2D–F). After pre-dilation with a 2.0-mm scoring balloon (Lacrosse NSE, Nipro, Osaka, Japan) we treated the restenotic lesion with a 2.0 × 20-mm drug-eluting balloon (SeQuent Please; B Braun, Melsungen, Germany), and the final result was good.

Discussion

Concerns persist regarding the risk of stent thrombosis with the double-kissing crush technique and the optimum duration of double anti-platelet therapy because of the three layers of metal stents, although the DKCRUSH study demonstrated a similar stent thrombosis rate between the double-kissing crush technique and the provisional stenting technique [3]. The stenting technique used for the 0,0,1 lesion in the present case was similar to the double-kissing crush technique but lacked main-vessel stenting; therefore, the protruding crushed segment could not be supported apposing to the vessel wall by a main vessel stent, although the crushed segment had two metal layers. For this reason, concerns remain about malapposition of crushed stent struts and the consequent risk of stent thrombosis, although we observed no major cardiovascular events in our report on the feasibility of the present stenting technique [2]. Optical coherence tomography in the present case clearly revealed that the stent struts had been almost completely crushed and covered after the implantation, which might resolve such concerns and support the feasibility of this treatment.

We used the Promus Element stent (Boston Scientific) for the present technique in the previous report [2], however, we implanted a Synergy stent, which has a similar stent platform design to the Promus Element stent [4], in the present case, because the Promus Element stent had been withdrawn from use in Japan. The easy deformability of the Synergy stent same as the Promus Element stent is an important factor in the present technique, as this feature might make it possible for us to crush the stent into an extremely thin crescent shape from a round shape on cross-section, and the extremely thin crushed segment might be associated with the good neointimal coverage. In addition, the Synergy stent was reported to have a higher proportion of covered struts in the early phase after ST-elevation myocardial infarction [5], and thus thinner stent struts and biodegradable polymer of the Synergy stent might be also factors associated with vascular healing. Moreover from this point of view, the Synergy stent might be suitable for side-branch stenting in the double-kissing crush technique as well as for the present technique.

The present stenting technique is simple and easy but needs several important steps for the success. First, we should measure the lumen diameter of the main vessel at the bifurcation with an intra-coronary imaging modality to prevent main vessel damage. It is better to crush the protruding stent segment with a balloon selected according to the lumen size and, if the crush is not complete, a bigger

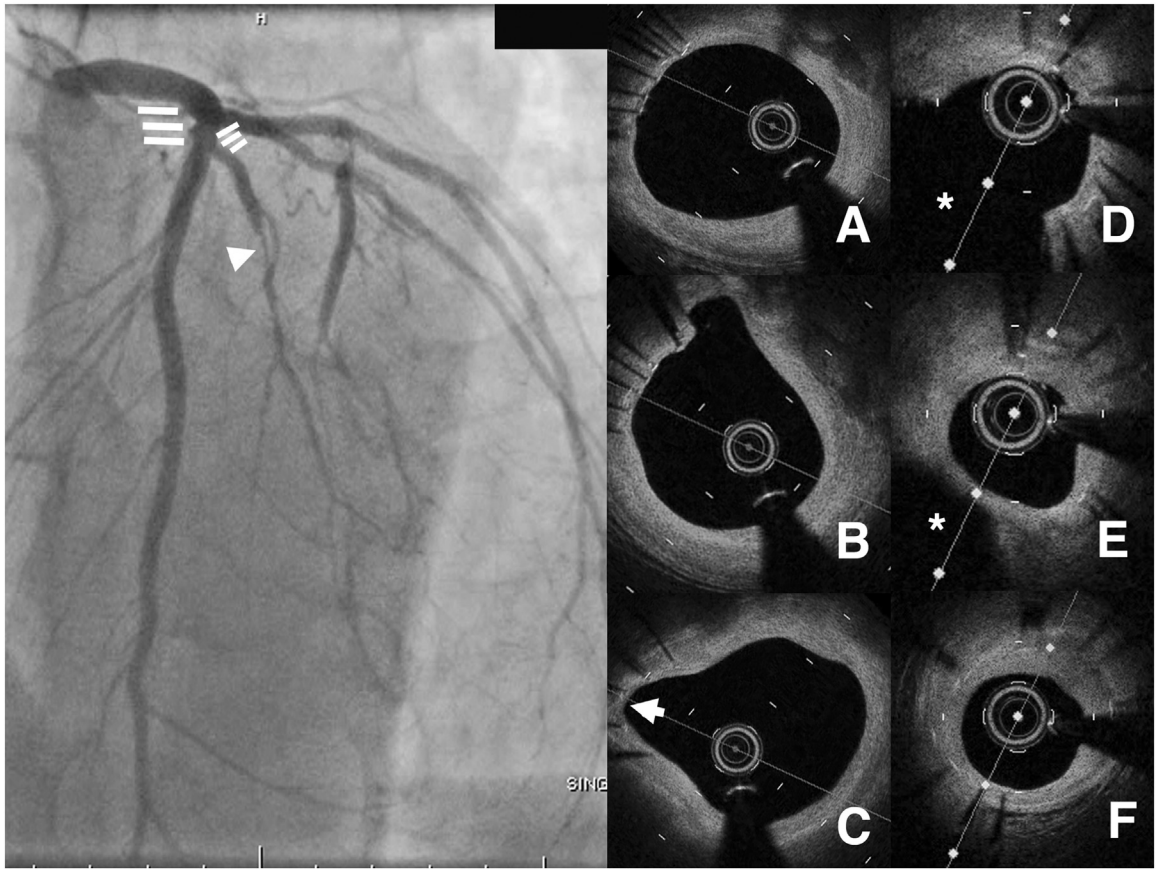

Fig. 2. Follow-up coronary angiography in the left oblique-cranial view showed severe restenosis in the distal edge of the stent (arrowhead), while the ostial lesion was patent. The bars indicate the position of optical coherence tomography, and A–C (the main vessel) and D–F (the diagonal branch) were assigned from the proximal to the distal sites. Optical coherence tomography showed that the crushed segment had been almost completely covered (A–C), and intimal hyperplasia in the stent was mild. The arrow indicates the diagonal branch and the asterisks indicate the main vessel.

balloon should be used, like in the present case. Second, the position of ballooning is also important. We should put the distal balloon marker just distal to the bifurcation carina and inflate the balloon to a low pressure according to the distal lumen size, and then, move the marker to just proximal to the carina and inflate to a high pressure according to the proximal lumen size. Third, the protrusion of the stent into the main vessel should be sufficient, because the proximal end of the Synergy stent has a 4-link structure [6]. It is better to re-cross a guide wire avoiding the 4-link structure segment the length of which is 2.83 mm in the case of a stent of 2.25 mm in diameter. The precise identification of the bifurcation point on fluoroscopy with an intra-coronary imaging modality is helpful for achieving the optimal protrusion. Fourth, the guide wire should be re-crossed at the middle point of the side branch ostium, because distal crossing might lead to gaps in stent scaffolding [7].

In conclusion, side branch stenting with a balloon crushing a protruding stent segment into the main vessel was effective for the 0,0,1 lesions, and the good neointimal coverage of the crushed segment on follow-up optical coherence tomography supports the feasibility of this treatment strategy.

Conflict of interest

The authors declare that there is no conflict of interest.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jccase.2019.02.009.

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