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Case Reports

Freedom From Stent Fracture–Related Complications of Vascular Longitudinal Remodeling in a Patient With Heart Failure and a Degraded Bioresorbable Vascular Scaffold

Chi-Jen Chang, MD[1]; Chien-Lin Lee, MD[2]; Jen-Fang Cheng, MD[3]; Yi-Chih Wang, MD[3]; Juey-Jen Hwang, MD[3]

[1]Cardiovascular Division, Department of Internal Medicine, Chang Gung Memorial Hospital, Linkou, Taoyuan, Taiwan
[2]Cardiovascular Division, Department of Internal Medicine, Far Eastern Memorial Hospital, New Taipei City, Taiwan
[3]Cardiovascular Division, Department of Internal Medicine, National Taiwan University Hospital, Taipei, Taiwan

Abstract

Because vascular geometric change during the long-term process of cardiac chamber remodeling in heart failure is usually unpredictable after coronary stenting, the risk of acquired metallic stent fracture can persist. This rare but possible complication could be minimized with the implantation of bioresorbable vascular scaffold because of its unique properties. Here, the authors report on 1 patient with heart failure who received optical coherence tomography evaluation between 3 and 3.5 years after bioresorbable vascular scaffold implantation. Measurement of the discernible struts of bioresorbable vascular scaffold provided evidence of coronary longitudinal remodeling without serious risk of complications related to metallic stent fracture resulting from cardiac remodeling.

Keywords: Tomography, optical coherence; stents; heart failure; remodeling, vascular

Introduction

Acquired coronary stent fracture[1] resulting from unexpected vascular or cardiac remodeling is a rare but possible metallic stent–related long-term complication. This complication theoretically could be minimized if bioresorbable vascular scaffold (BVS) (Absorb; Abbott Vascular) is implanted and then allowed to degrade. Optical coherence tomography (OCT) evaluation of a patient 39 months after BVS treatment for heart failure with reduced ejection fraction (HFrEF) showed remaining discernible struts, with the evidence of coronary longitudinal remodeling not causing serious concern for stent fracture, which typically occurs in metallic stents.

Case Report

A 60-year-old man with hypertension, diabetes, and hyperlipidemia underwent coronary angioplasty for effort angina and documented severe stenosis in the proximal left anterior descending coronary artery (LAD) with reduced left ventricular EF (LVEF, 43%) and mild apical hypokinesia on coronary computed tomography angiography.

Technique

A diagnostic coronary angiogram produced the same finding (Fig. 1A and 1B), and a 3.0-×18-mm BVS was implanted for the critically stenotic lesion. An angiogram of the LAD after dilatation with a 3.5-×15-mm noncompliant balloon at 20 atm is shown in Figure 1C. The LV end-diastolic volume (LVEDV) decreased initially from 262 to 127 mL after BVS implantation, with the LVEF increasing from 43% to 56%.

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Corresponding author: Yi-Chih Wang, MD, No. 7, Chung-San South Rd, National Taiwan University Hospital, Taipei, Taiwan, 100 (med011@seed.net.tw)

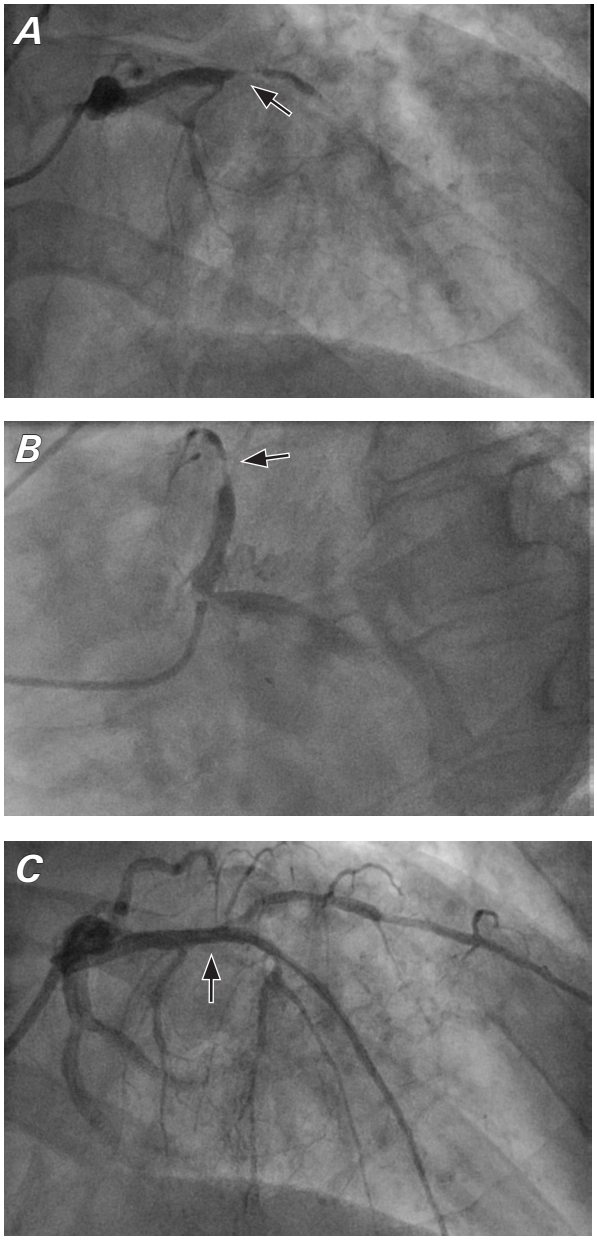

Fig. 1 First diagnostic coronary angiogram for a 60-year-old man. **A**) The critical and discrete lesion at the proximal LAD is shown in a right anterior oblique-cranial view (arrow). **B**) The LAD lesion shown in the left anterior oblique-caudal view (arrow). **C**) The arrow shows the LAD after 1 implantation of a bioresorbable 3.0- × 18-mm vascular scaffold with a 3.5- × 15-mm noncompliance balloon for postdilatation.

LAD, left anterior descending coronary artery.

The patient developed recurrent chest tightness, however, with a positive stress test 39 months later. In addition, LVEDV increased to 158 mL, LVEF decreased to 37%, and severe apical hypokinesia was found. Therefore, he underwent another coronary angiography, which showed only severe stenosis at the distal LAD without significant restenosis at the stent site (Fig. 2A). The distal lesion was treated using a 2.5- × 28-mm drug-eluting stent. The OCT demonstrated a degraded but discernible BVS within the vessel wall. Notably, the entire length of the visible scaffold, from distal (Fig. 2B) to proximal (Fig. 2C), was 20.5 mm, which represented 13.9% elongation compared with the original length of the BVS (Fig. 2). Nevertheless, there was no concern about permanent stent fracture because the BVS was designed to resorb completely.

Abbreviations and Acronyms

BVS	bioresorbable vascular scaffold
HFrEF	heart failure with reduced ejection fraction
LAD	left anterior descending coronary artery
OCT	optical coherence tomography

Discussion

For metallic stents, several factors, including stent overlap, longer stent length, right coronary artery location, calcified or tortuous lesions, lesions with high angulation, and stent overexpansion, are associated with the risk of stent fracture.[1] Acquired coronary stent fracture resulting from unexpected vascular or cardiac remodeling is rare but possible. Stent fracture has been reported to be associated with clinical events, as well.[2] One meta-analysis[3] evaluating stent fractures from 8 studies with 108 cases suggested that lesions with stent fractures had higher rates of in-stent restenosis (38% vs 8.2%; $P<.01$) and target lesion revascularization (17% vs 5.6%; $P<.01$) than those without.

Fully bioresorbable scaffolds were fundamentally designed to minimize the potential long-term adverse effect of metallic stents. Results from large, randomized clinical trials, however, raised concerns that there could be a higher risk of device thrombosis with the BVS than with the cobalt-chromium everolimus-eluting stent, especially when bioresorption was ongoing.[4] Because of safety issues, the manufacturer discontinued the device. In patients with HFrEF, LV chamber size was more vulnerable to fluid overload than in those with normal EF. Besides chronic remodeling, serial chest x-ray or echocardiography occasionally showed that the LV size of the population with HF could change significantly either during acute decompensation or because of diuretic use in clinical practice. This case report showed unexpected elongation of the BVS. With such vascular remodeling, the patient could have been at risk for potential stent fracture–related complications if a metallic stent had been implanted. As shown in this case with

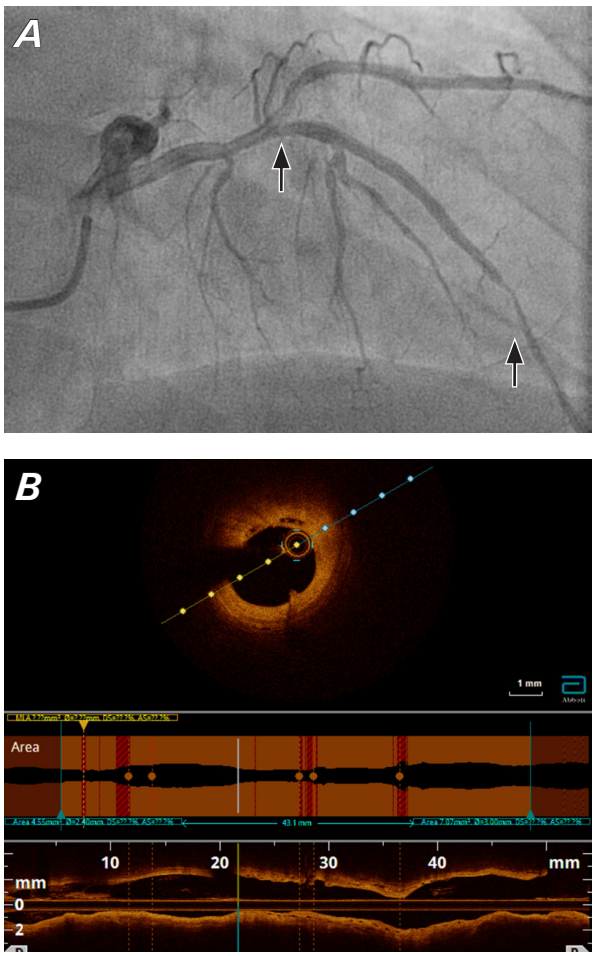

Fig. 2 Follow-up coronary angiogram in a 60-year-old man 39 months after vascular scaffold implantation. **A**) Severe stenosis at the distal LAD without significant restenosis at the stent site. **B**) Optical coherence tomogram shows the most distal discernible BVS within the vessel wall. (Supplemental motion image is available for Figure 2B.) **C**) Optical coherence tomogram shows the most proximal discernible BVS within the vessel wall. The entire length, from distal to proximal visible struts, was 20.5 mm. The mean and minimum cross-sectional areas were 7.04 mm^2 and 3.62 mm^2, respectively.

Supplemental motion image is available for Figure 2C.

BVS, bioresorbable vascular scaffold; LAD, left anterior descending coronary artery.

HFrEF, however, the BVS still has a favorable impact on reducing the longer-term risk of stent fracture because of unpredictable but possible HF-related cardiac remodeling.

The timing of the follow-up angiography and OCT is crucial in this case. During the process of BVS degradation, polymer is gradually replaced by an increasingly cellular matrix. Although the BVS polymer would be expected to dissolve completely within 3 years after implantation, the space left behind would gradually be occupied by cellular matrix within 5 years. At 5 years after implantation, the stented segment would become a "golden tube" on OCT imaging, with no visible box-shaped appearance.[5] Thus, because of the visible, box-shaped space at 39 months after BVS implantation in the current case report, the authors could accurately measure the total length of the BVS based on its distal and proximal box-shaped appearance.

To the authors' knowledge, this report is the first to show vascular longitudinal remodeling more than 3 years after BVS implantation in a patient with HFrEF. The OCT images suggested that the patient was free from potential adverse events resulting from stent fracture, which can occur in metallic stents in the long term. The authors did not perform OCT to confirm the initial length of the BVS just after implantation, and the single case described here did not allow conclusions about the true clinical impact of the BVS; however, the findings imply a longer-term benefit of BVSs for patients with HF if the improved design of next-generation BVSs could reduce the risk of scaffold thrombosis during bioresorption.

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Conflict of Interest Disclosures: None

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References

1. Nakazawa G, Finn AV, Vorpahl M, et al. Incidence and predictors of drug-eluting stent fracture in human coronary artery: a pathologic analysis. *J Am Coll Cardiol.* 2009;54(21):1924-1931. doi:10.1016/j.jacc.2009.05.075
2. Chhatriwalla AK, Cam A, Unzek S, et al. Drug-eluting stent fracture and acute coronary syndrome. *Cardiovasc Revasc Med.* 2009;10(3):166-171. doi:10.1016/j.carrev.2009.02.003
3. Chakravarty T, White AJ, Buch M, et al. Meta-analysis of incidence, clinical characteristics and implications of stent

fracture. *Am J Cardiol.* 2010;106(8):1075-1080. doi:10.1016/j.amjcard.2010.06.010

4. Ali ZA, Serruys PW, Kimura T, et al. 2-Year outcomes with the Absorb bioresorbable scaffold for treatment of coronary artery disease: a systematic review and meta-analysis of seven randomized trials with an individual patient data substudy. *Lancet.* 2017;390(10096):760-772. doi:10.1016/S0140-6736(17)31470-8
5. Karanasos A, Simsek C, Gnanadesigan M, et al. OCT assessment of the long-term vascular healing response 5 years after everolimus-eluting bioresorbable vascular scaffold. *J Am Coll Cardiol.* 2014;64(22):2343-2356. doi:10.1016/j.jacc.2014.09.029