Restenosis of a drug eluting stent on the previous bioresorbable vascular scaffold successfully treated with a drug-coated balloon: A case report

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Abstract

BACKGROUND
The in-stent restenosis (ISR) rates are reportedly inconsistent despite the increased use of second-generation drug eluting stent (DES). Although bioresorbable vascular scaffold (BVS) have substantial advantages with respect to vascular restoration, the rate of scaffold thrombosis is higher with BVS than with DES. Optimal treatment strategies have not been established for DES-ISR to date.

CASE SUMMARY
We report on a case of a 60-year-old man patient with acute coronary syndrome. He had a history of ST-segment elevation myocardial infarction associated with very late scaffold thrombosis and treated with a DES. Coronary angiography revealed significant stenosis, suggesting DES-ISR on the previous BVS. Optical coherence tomography (OCT) identified a plaque rupture and disrupted scaffold strut in the neointimal proliferation of DES. To treat the DES-ISR on the previous BVS, we opted for a drug-coated balloon (DCB) after a balloon angioplasty using a semi-compliant and non-compliant balloon. The patient did not experience adverse cardiovascular events on using a DCB following the use of intensive dual antiplatelet therapy and statin for 24 mo.

CONCLUSION
This case highlights the importance of OCT as an imaging modality for characterizing the mechanism of target lesion failure. The use of a DCB following
A 60-year-old man was referred to the emergency room with a complaint of chest pain. Patient’s symptoms started a 3 d ago with recurrent episodes during exertion, which had worsened the last 1 h.

History of present illness
Patient’s symptoms started a 3 d ago with recurrent episodes during exertion, which had worsened the last 1 h.

History of past illness
He had a history of unstable angina treated with a BVS (3.5 mm × 18 mm Absorb GT1 everolimus-eluting bioresorbable scaffold, Abbott Vascular, Santa Clara, CA, United States) in the proximal left anterior descending artery (LAD) 36 mo prior to the current presentation (Figure 1). Twenty months ago, he was diagnosed with ST-segment elevation myocardial infarction associated with very late scaffold thrombosis (Figure 2A). A red thrombus associated with disruption of the scaffold strut was identified on OCT (Dragonfly, St. Jude Medical, St. Paul, MN, United States; Figure 2B). We treated the patient with a DES (3.5 mm × 33 mm XIENCE everolimus-eluting stent, Abbott Vascular, Santa Clara, CA, United States), covering the whole...
Physical examination
The patient’s blood pressure was 130/80 mmHg, heart rate was 66 bpm, respiratory rate was 14 breaths per minute, temperature was 36.8 °C, and oxygen saturation in room air was 98%.

Laboratory examinations
Baseline electrocardiography showed Q waves in precordial leads and blood test including cardiac enzymes were normal.

Imaging examinations
Coronary angiography (CAG) revealed tight stenosis (diameter > 90%) of the proximal LAD, suggesting DES-ISR on the previous BVS (Figure 3A). OCT indicated plaque rupture and a disrupted scaffold strut in the neointimal proliferation of DES (Figure 3B).

FINAL DIAGNOSIS
The final diagnosis of the presented case is unstable angina associated with restenosis of a DES on the previous BVS.

TREATMENT
We performed a balloon angioplasty using a 2.5 mm × 20 mm semi-compliant balloon and a 3.0 mm × 12 mm non-compliant balloon to treat the DES-ISR on the previous BVS. We opted for a drug-coated balloon (DCB) rather than a DES. After placement of the DCB (3.5 mm × 26 mm SeQuent Please paclitaxel-eluting balloon, B. Braun, Melsungen, Germany) at 16 atm (up to diameter 4.0 mm, for 60 min), CAG revealed an acceptable residual stenosis of < 10% (Figure 3C). OCT showed achievement of optimal luminal gain (minimal/mean lumen diameter, 3.25/3.45 mm, minimal lumen area, 9.45 mm², Figure 3D). He was discharged on the day after the procedure and was prescribed 90 mg ticagrelor twice daily, 100 mg aspirin daily, and 20 mg rosuvastatin daily.

OUTCOME AND FOLLOW-UP
The patient had an uneventful clinical course for 24 mo. At 12 mo follow-up, we deescalated to 60 mg ticagrelor twice daily.

DISCUSSION
We report a case of ACS caused by restenosis of a second-generation DES on the previous BVS. The patient did not experience adverse cardiovascular events on using a DCB following the use of intensive dual antiplatelet therapy (DAPT) and statin for 12 mo.

In patients with coronary artery stenosis who receive a metallic DES, adverse events, such as late TLF may be related, in part, to the persistent presence of the metallic stent frame in the coronary vessel wall[3]. Theoretically, the use of a BVS was considered a promising treatment for coronary artery disease associated with a favorable tissue response[4]. However, the cumulative 5-year adverse event rates were higher in patients with a BVS than in those with DESs; thus, restricted use of BVSs was noted in current clinical practice[5].

Recent real-world long-term data reported that lesion complexity and more pronounced cardiovascular risk factors were the determinants of TLF of BVS[6]. In this case, very late scaffold thrombosis was associated with peri-strut low-intensity area and strut discontinuity[7]. We used the DES to cover the entire segment of the previous scaffold, following the administration of continuous intensive DAPT with ticagrelor and aspirin. Unfortunately, the patient experienced an emergent revascularization sequence of the previous scaffold (Figure 2C and D).
after the procedure, and we performed OCT-guided PCI using a DCB.

In contemporary clinical practice, the management of ISR remains challenging. When selecting a treatment strategy for ISR, the specific advantages and disadvantages of DESs and DCBs should be carefully weighed. Although the use of a DES resulted in superior late angiographic findings in the treatment of ISR⁸, repeat implantation of a DES remains, arguably, the most widely used treatment strategy. The use of a DCB for ISR is an effective treatment option; additional stent implantation
Figure 3 Restenosis of the drug eluting stent on the previous bioresorbable vascular Scaffold. A: Coronary angiography image showing significant stenosis in the proximal left anterior descending artery; B: Optical coherence tomography image showing plaque rupture and a disrupted scaffold strut in the neointimal proliferation of drug eluting stent; C: Angiography image showing optimal diameter gain by the drug-coated balloon; D: Optical coherence tomography image showing achievement of optimal luminal gain.

is hence, not required and the outcomes are similar with those noted with TLR\cite{9}. Thus, the use of a DCB can be an attractive treatment option for patients with recurrent stent or scaffold failure.

To best our knowledge, this case report of ACS by restenosis of second-generation DES on the prior BVS is the earliest in the literature. In this case, the structural deformities associated with the previous BVS such as, disruption of the scaffold strut, were identified as a risk factor for TLF. Hence, tailored strategies involving imaging-guided PCI following intensive medical treatment are necessary to prevent thrombosis and neo-atherosclerosis after the implantation of a BVS and DES\cite{10-12}. To the best of our knowledge, the presented case is the first in the literature describing the evolution of ACS associated with restenosis of a DES on the previous BVS.

**CONCLUSION**

This case highlights the importance of OCT as an imaging modality for characterizing the mechanism of target lesion failure. The use of a DCB following the administration of optimal pharmacologic therapy may be an optimal strategy for the treatment and prevention of recurrent BVS thrombosis and DES-ISR.

**REFERENCES**

1. **Dangas GD**, Claessen BE, Caixeta A, Sanidas EA, Mintz GS, Mehran R. In-stent restenosis in the drug-eluting stent era. *J Am Coll Cardiol* 2010; 56: 1897-1907 [PMID: 21109112 DOI: 10.1016/j.jacc.2010.07.028]

2. **Siontis GC**, Stefanini GG, Mavridis D, Siontis KC, Alfonso F, Pérez-Vizcayno MJ, Byrne RA,
Kastrati A, Meier B, Salanti G, Juni P, Windecker S. Percutaneous coronary artery intervention: strategies for treatment of in-stent restenosis: a network meta-analysis. Lancet 2015; 386: 655-664 [PMID: 26334160 DOI: 10.1016/S0140-6736(15)60657-2]

3 Ellis SG, Kereiakes DJ, Metzger DC, Caputo RP, Rizik DG, Teirstein PS, Litt MR, Kini A, Kabour A, Marx SO, Popma JJ, McGreavy R, Zhang Z, Simonton C, Stone GW; ABSORB III Investigators. Everolimus-Eluting Bioresorbable Scaffold for Coronary Artery Disease. N Engl J Med 2015; 373: 1905-1915 [PMID: 26457558 DOI: 10.1056/NEJMoa1509038]

4 Karanasos A, Simsek C, Gnanadesigan M, van Ditzhuijzen NS, Freire R, Dijkstra J, Tu S, Van Mieghem N, van Soest G, de Jaegere P, Serruys PW, Zijlstra F, van Geuns RJ, Regar E. OCT assessment of the long-term vascular healing response 5 years after everolimus-eluting bioresorbable vascular scaffold. J Am Coll Cardiol 2014; 64: 2343-2356 [PMID: 25465421 DOI: 10.1016/j.jacc.2014.09.029]

5 Kereiakes DJ, Ellis SG, Metzger DC, Caputo RP, Rizik DG, Teirstein PS, Litt MR, Kini A, Kabour A, Marx SO, Popma JJ, Tan SH, Ediebah DE, Simonton C, Stone GW; ABSORB III Investigators. Clinical Outcomes Before and After Complete Everolimus-Eluting Bioresorbable Scaffold Resorption: Five-Year Follow-Up From the ABSORB III Trial. Circulation 2019; 140: 1895-1903 [PMID: 31553222 DOI: 10.1161/CIRCULATIONAHA.119.042584]

6 Wiebe J, Baquet M, Dörö O, Hoppmann P, Joehchum D, Rheyne T, Boeder N, Grundman D, Blachutziuk T, Theiss H, Cassesse S, Hofmann FJ, Gschwendtner S, Elsässer A, Massberg S, Hamm C, Laugwitz KL, Byrne RA, Mehilli J, Kastrati A, Nef H. Long-term follow-up and predictors of target lesion failure after implantation of everolimus-eluting bioresorbable scaffolds in real-world practice. Int J Cardiol 2020; 312: 42-47 [PMID: 32151443 DOI: 10.1016/j.ijcard.2020.02.062]

7 Cuculli F, Paricle S, Jamshidi P, Valentin J, Kallinikou Z, Toggweiler S, Weissner M, Münzel T, Cook S, Gori T. Optical Coherence Tomography Findings in Bioresorbable Vascular Scaffolds Thrombosis. Circ Cardiovasc Interv 2015; 8: e002518 [PMID: 26399265 DOI: 10.1161/CIRCINTERVENTIONS.114.002518]

8 Alfonso F, Pérez-Vizcaíno MJ, Cárdenas A, García del Blanco B, García-Touchard A, López-Mingué JR, Benedicto A, Masotti M, Zueco J, Velázquez M, Moreno R, Mainar V, Dominguez A, Pomar F, Melgares R, Rivero F, Jiménez-Quevedo P, Gonzalo N, Fernández C, Minguéz JR, Benedicto A, Marx SO, Popma JJ, McGreevy R, Zhang Z, Stone GW; ABSORB III Investigators. Neoatherosclerosis 5 Years After Bioresorbable Vascular Scaffold Implantation. J Am Coll Cardiol 2018; 71: 275-283 [PMID: 29413242 DOI: 10.1016/j.jacc.2017.10.024]

9 Baan J Jr, Claassen BE, Dijk KB, Vendrik J, van der Schaaf RJ, Meuwissen M, van Royen N, Gosselink ATM, van Wely MH, Drikali A, Arkenbout EK, de Winter RJ, Koch KT, Sjauw KD, Beijk MA, Vis MM, Wykrzykowska JJ, Piek JJ, Tijsen AGP, Henriques JPS. A Randomized Comparison of Paclitaxel-Eluting Balloon Versus Everolimus-Eluting Stent for the Treatment of Any In-Stent Restenosis: The DARE Trial. JACC Cardiovasc Interv 2018; 11: 275-283 [PMID: 29413242 DOI: 10.1016/j.jcmi.2017.10.024]

10 Moriyama N, Shishido K, Tanaka Y, Yokota S, Hayashi T, Miyashita H, Koike T, Yokoyama H, Takada T, Nishimoto T, Ochiai T, Tobita K, Yamanaka F, Mizoza S, Murakami M, Takahashi S, Saito S. Neoatherosclerosis 5 Years After Bioresorbable Vascular Scaffold Implantation. J Am Coll Cardiol 2018; 71: 1882-1893 [PMID: 29699614 DOI: 10.1016/j.jacc.2018.02.051]

11 Wallentin L, Becker RC, Budaj A, Cannon CP, Emanuelsson H, Held C, Morrow J, Husted S, James S, Satus H, Mahaffey KW, Scirica BM, Skene A, Steg PG, Storey RF, Harrington RA; PLATO Investigators; Freij A; Thorsén M. Ticagrelor versus clopidogrel in patients with acute coronary syndromes. N Engl J Med 2009; 361: 1045-1057 [PMID: 19717846 DOI: 10.1056/NEJMoa0904327]

12 Gili S, Iannaccone M, Colombo F, Montefusco A, Amabile N, Calcagno S, Capodanno D, Scalone G, Rognoni A, Omedè P, Ugo F, Cavallo E, Mancone M, Manguamieli A, Boccuzzi G, Hiansen J, Motreff P, Toutouzas K, Garbo R, Sardella G, Tamburino C, D’Amico M, Moretti C, Templin C, Gaïa F, Souteyrand G, Nicoleti G, D’Ascanio F. Effects of statins on plaque rupture assessed by optical coherence tomography in patients presenting with acute coronary syndromes: insights from the optical coherence tomography (OCT)-FORMIDABLE registry. Eur Heart J Cardiovasc Imaging 2018; 19: 524-531 [PMID: 28605473 DOI: 10.1093/ehjci/jex102]
