ESC European Society of Cardiology

European Heart Journal - Case Reports (2024) **8**, 1–6
https://doi.org/10.1093/ehjcr/ytae065

CASE REPORT
Coronary intervention

Late acquired coronary aneurysm and restenosis after bioresorbable vascular scaffold implantation: a case report

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Received 17 July 2023; revised 22 January 2024; accepted 26 January 2024; online publish-ahead-of-print 30 January 2024

Background Although the technology of bioresorbable vascular scaffold (BVS) aroused the peak of interest a few years ago and currently remains available only as part of experimental research, patients who have had BVS implanted should be still carefully monitored to detect possible long-term complications.

Case summary We present the case of a 47-year-old man who had received BVS implantation for ST-segment elevation myocardial infarction. Six years later, computed tomography coronary angiography (CTCA) demonstrated in-segment restenosis in between two newly formed coronary aneurysms at the site of the implanted BVS. The patient received successful optical coherence tomography–guided percutaneous intervention with a new metallic drug-eluting stent implantation.

Discussion Our case demonstrates that coronary aneurysms can be well characterized with CTCA and are often incidentally discovered as they cause no symptoms. The incidence of coronary aneurysm at the site of a previously implanted BVS is not defined, and little is known about the pathophysiology and evolution of these lesions. Therefore, the decision to proceed with conservative management or intervention must be tailored to the clinical conditions of the patient, the anatomy, the rapidity of growth, and the possible thrombotic burden.

Keywords Coronary aneurysm • Drug-eluting stent • Coronary angiography • Computed tomography • Percutaneous coronary intervention • Bioresorbable vascular scaffold • Case report

ESC curriculum 2.1 Imaging modalities • 2.4 Cardiac computed tomography • 3.1 Coronary artery disease • 3.3 Chronic coronary syndrome • 3.4 Coronary angiography

Learning points

- Coronary aneurysms are often incidentally discovered at computed tomography coronary angiography as they cause no symptoms and multimodality imaging is an unvaluable tool to define the patho-anatomy.
- The incidence of coronary aneurysm at the site of a previously implanted bioresorbable vascular scaffold is not defined, and little is known about their pathophysiology and evolution.
- The decision to manage any coronary aneurysm conservatively or to proceed with percutaneous intervention must be individualized according to the history and clinical presentation, the anatomy, the rapidity of growth, and the possible thrombotic burden.

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Handling Editor: Milenko Zoran Cankovic
Peer-reviewers: Raheel Ahmed, Piotr Nikodem Rudzínski, and Dragana Dabovic
Compliance Editor: Niklas Schenker
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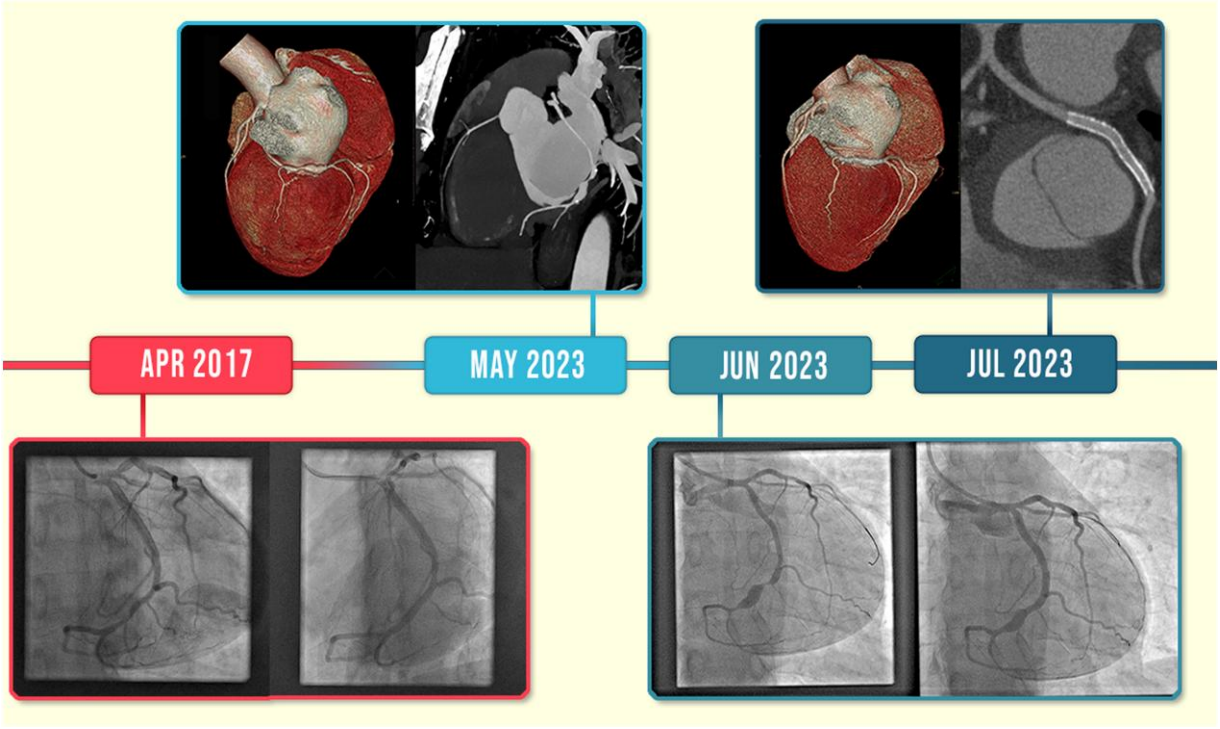
Introduction

While the technology of bioresorbable vascular scaffold (BVS) peaked in interest a few years ago and is currently available only in experimental research,[1] patients with BVS implants should still be carefully monitored for potential long-term complications.[2] Aneurysm formation is a possible late complication of BVS implantation.[3] Pathology and pathophysiology of this condition remain largely unexplored, and multimodality coronary imaging is a valuable tool to study the anatomical features of coronary artery aneurysms and possibly plan a percutaneous intervention.

Summary figure



April 2017: Baseline and final angiogram after BVS implantation in the mid left circumflex artery (LCx).

May 2023: At computed tomography coronary angiography (CTCA), a stenosis between two aneurysmal segments in the mid LCx and two metallic spots at the edges of the diseased segment are observed.

June 2023: Baseline and final angiogram after optical coherence tomography (OCT)–guided implantation of a long metallic drug-eluting stent (DES) in the mid LCx.

July 2023: Follow-up CTCA confirms the successful DES implantation with patency of the obtuse marginal branch emerging from the stented segment and a near-complete disappearance of the aneurysmatic lesions, except for a small portion of the bigger distal aneurysm.

Case presentation

A heavy smoker Caucasian 47-year-old man with hypercholesterolaemia was admitted to our department for elective coronary angiography. Six years before, the patient had been hospitalized for a posterior ST-segment elevation myocardial infarction (STEMI). At that time (Summary figure), he had received primary percutaneous coronary intervention (PCI) with implantation (see Supplementary material online, *Video S1*) of a BVS (Absorb BVS 3.5 × 23 mm, Abbott Vascular) in the mid segment of a dominant LCx. The in-hospital course had been uncomplicated, and he had been discharged on dual antiplatelet therapy (DAPT) with aspirin and clopidogrel, which were continued thereafter also because the patient did not quit smoking, and on atorvastatin 80 mg daily, which was reduced to 40 mg 1 month later.

Recently, he had undergone CTCA in the preoperative work-up for spine surgery. Computed tomography coronary angiography had revealed (Summary figure) a stenosis between two aneurysmal segments in the LCx; of note, two metallic spots were evident at the proximal and distal sites of the diseased segment. Physical examination and electrocardiogram were unremarkable. He was still on DAPT and atorvastatin, 40 mg daily; LDL cholesterol was 92 mg/dL. Other laboratory values were unremarkable but white cell count (13 100/mmc, 77% neutrophils) and alpha 1 and alpha 2 globulins, which were above the normal range.

Transradial[4] coronary angiography confirmed the stenosis in the mid LCx between two focal aneurysmal segments in the same site of the previously implanted BVS. No indication to either conservative treatment or intervention was possible at this stage, and further investigations were deemed necessary to investigate both pathophysiology of the lesion as well as the vascular structure of such a diseased segment. The stenosis was interrogated (*Figure 1*) with a pressure wire (OptoWire, OpSens Medical), which confirmed the haemodynamic significance [fractional flow reserve (FFR) was 0.79 with an evident pressure gradient at the site of the stenosis], and with an OCT probe

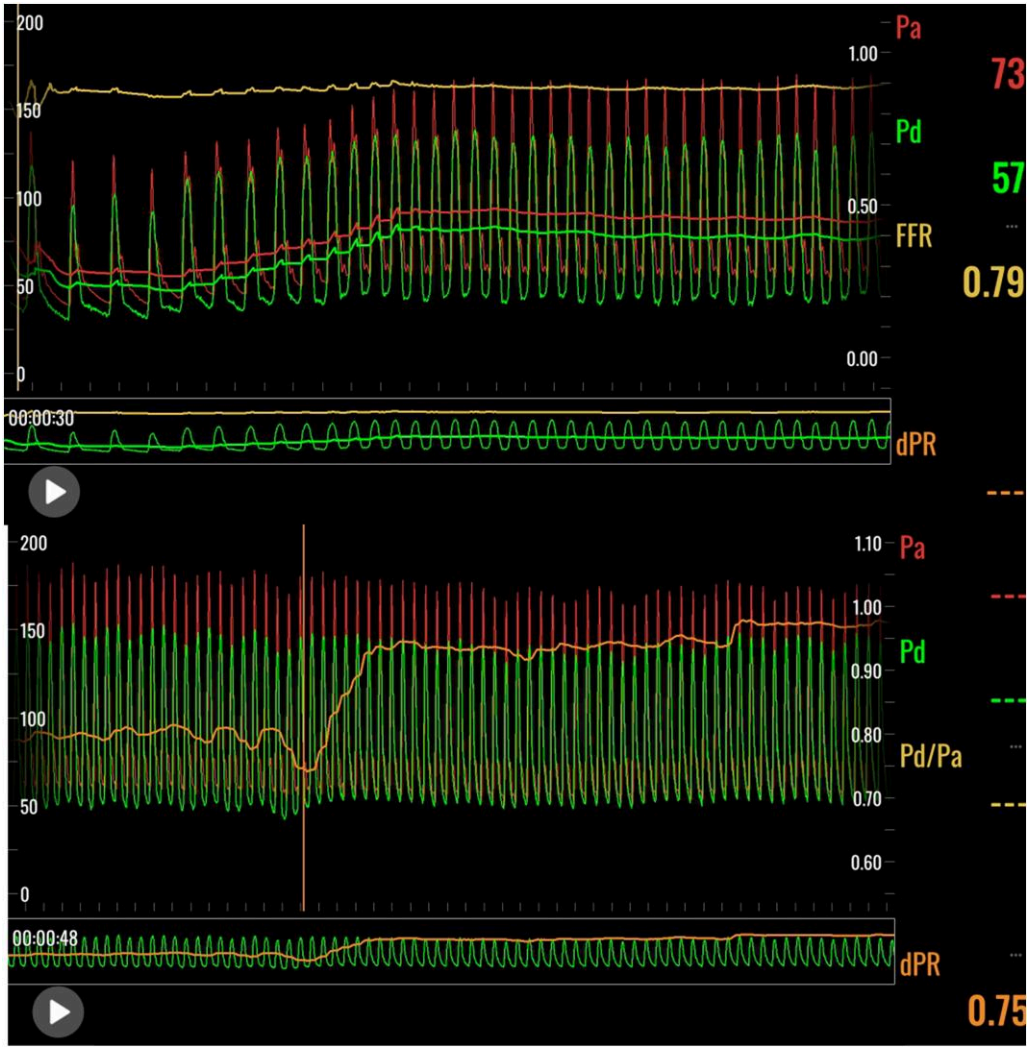


Figure 1 Pressure wire interrogation. Top: lesion interrogation with pressure wire demonstrates an ischaemic fractional flow reserve. Bottom: an evident step is observed at the stenosis site during pressure wire pullback.

(Dragonfly OPTIS Imaging Catheter, Abbott Vascular). At OCT interrogation (*Figure 2*), no residual struts of the previously implanted BVS were apparent and the media was markedly thinned at the site of the aneurysmal dilatation; the stenosis consisted of a signal-poor plaque with high backscatter neo-intimal thickening, and the minimal lumen area (MLA) was 1.68 mm^2. Of note, the two metallic spots seen at CTCA, consistent with the proximal and distal permanent metallic markers of the remotely implanted Absorb BVS, were not clearly identifiable with OCT. Thus, we concluded that the BVS had been completely resorbed while a new in-segment stenosis had developed in between two in-segment newly acquired coronary aneurysms.

Ultimately, PCI was indicated. We identified with OCT a proximal and a distal landing zone not involved in aneurysmal dilatation and free from overt atherosclerotic disease. Since self-apposing coronary DESs are not available in the market anymore, a balloon-expandable everolimus-eluting stent (Synergy 3.0 × 38 mm, Boston Scientific), sized according to the distal reference area, was directly implanted at 16 atm; the proximal half was post-dilated up to 20 atm using a non-compliant 3.5 mm balloon (Summary figure; Supplementary material online, *Video S2*). A final OCT assessment (*Figure 3*) confirmed good stent expansion with 4.72 mm^2 in-stent MLA and struts apposition to the vessel walls in the proximal half and in the distal landing zone. As expected, stent struts were not apposed in the distal aneurysmal segment, where the maximal lumen area exceeded 21 mm^2, and we refrained to overexpand the stent with balloon dilatation to try to obtain strut apposition in this segment.

The patient had an uneventful recovery, and ezetimibe was added at discharge. At 1-month follow-up visit, clopidogrel discontinuation 5 days before intervention was recommended, without any bridging, and the patients underwent successful spine neurosurgery 2 weeks later. During such hospitalization, the patient underwent follow-up CTCA (Summary figure), which confirmed the successful DES implantation with patency of the obtuse marginal branch emerging from the stented segment and a near-complete disappearance of the aneurysmatic lesions, except for a small portion of the bigger distal aneurysm. After 2 months, the patient is still asymptomatic and receiving DAPT. Since the patient remains at high ischaemic and low bleeding risk, taking also into account his unhealthy habits, we plan to continue DAPT indefinitely as a general secondary prevention strategy and to optimize LDL cholesterol.

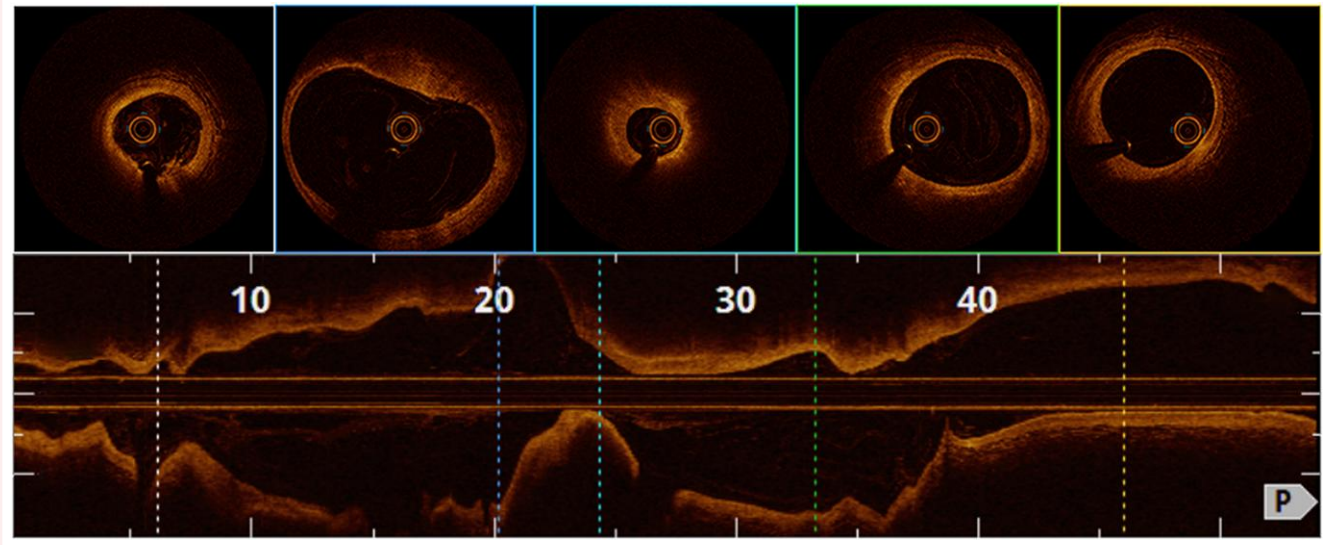


Figure 2 Baseline optical coherence tomography. Longitudinal reconstruction and cross-sections of interest before percutaneous coronary intervention showing the aneurysmal segments and the stenosis in between.

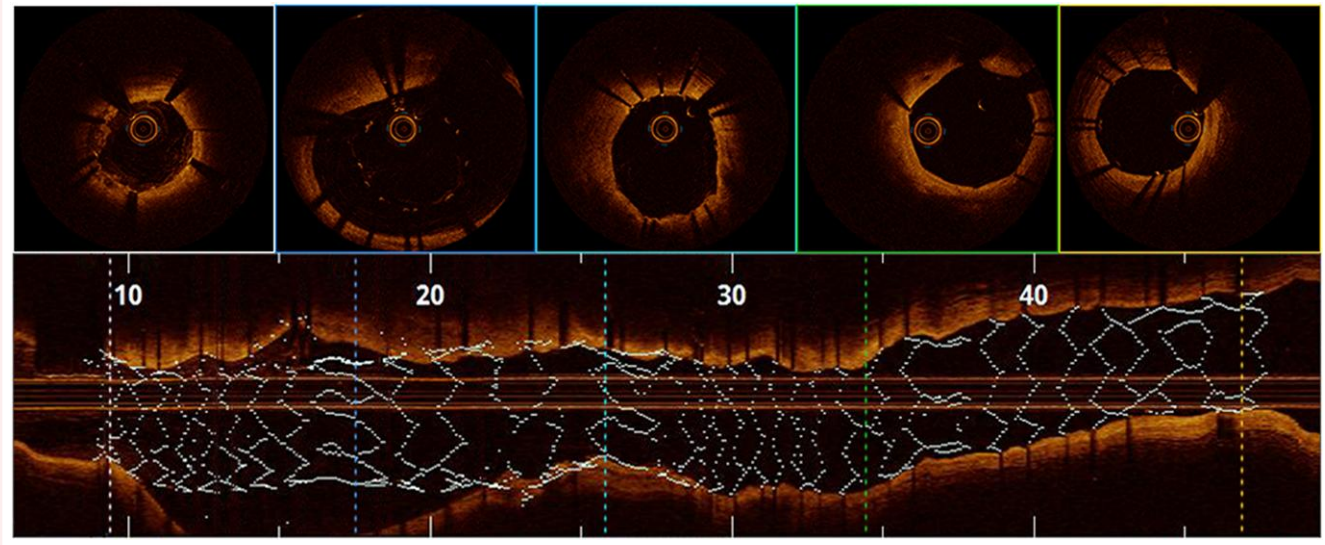


Figure 3 Post-percutaneous coronary intervention optical coherence tomography. Longitudinal reconstruction and cross-sections of interest after drug-eluting stent implantation: optimal expansion and strut apposition in the proximal half and in the distal landing zone are observed. Stent struts are not apposed in the distal aneurysm.

Discussion

After the initial enthusiasm about coronary BVS as compared to permanent metallic DES, their use has progressively decreased.[1] The progressive reabsorption of the device should have theoretically allowed to observe increase in luminal dimensions over time because of recovered vasomotion of the scaffolded vessel.[5] In addition, BVS disappearance would have allowed to avoid any complication associated with permanent metallic DES such as those related with thrombogenesis and long-term inflammation.[6] In randomized trials, however, increased rates of BVS thrombosis and target–lesion revascularization have been observed in the first 3 years after implantation,[7] with a lower event thereafter.[2] In a recent predictive model, the benefit of BVS over contemporary DES would become apparent only after 19 years, making them a preferred strategy only for a time horizon longer than 25 years.[8]

On this background, little is known about the long-term adverse events related to BVS. Our case report highlights an anecdotical mechanism of late BVS failure, that is coronary aneurysm formation coexisting with in-segment late loss leading to restenosis. Aneurysm formation after BVS implantation has been documented in case reports and retrospective registries[9] and has been observed up to 32 months after BVS implantation.[10] In the study by Gori *et al.*,[9] rate and severity of coronary evaginations were comparable to those of contemporary DES. Although the incidence of aneurysm formation after DES implantation in trials is <3%, the real incidence in unselected series remains unknown, as well as the actual rate of aneurysm formation after BVS implantation. A conservative approach has been generally chosen by prescribing DAPT to prevent aneurysm thrombosis,[3,10] whereas covered stents have been used to exclude the aneurysm whenever progressive growth over time is observed.[11] The use of oral anticoagulants (for instance a vascular dose of rivaroxaban, 2.5 mg twice daily) in addition to aspirin may be also considered for long-term thrombosis prevention in cases managed conservatively, especially whenever with polyvascular atherosclerotic disease is present.

Patients in whom a newly acquired aneurysmatic segment coexists with BVS restenosis are ever rarer. La Manna *et al.*[12] reported a case successfully managed with self-apposing coronary DES, which is known to self-adapt to vessel diameter and ensure optimal strut apposition even in the aneurysmatic segment. Both our case and the case of La Manna *et al.*[12] confirm that abnormal positive remodelling and restenosis may simultaneously occur in the same segment treated with BVS implantation. The mechanisms that cause the abnormal artery dilatation after BVS implantation are not fully understood; dissections and deep vessel injury, local inflammation, and hypersensitivity reaction with accumulation of T-lymphocytes and eosinophils in the arterial wall prompted by the drug, the polymer, or the device itself, pathological vessel healing with excessive remodelling, and even focal infections are likely to contribute to aneurysm formation.[13] Of note, we observed an increase in markers of systemic inflammation in our patient, both in terms of white cell count and of alpha globulins.

From the technical standpoint, we considered the possibility to implant a covered stent to exclude the aneurysm, but there was no device available on our market long enough to exclude both aneurysmal segments, and we did not want to implant two overlapping covered stents because of an unacceptable risk of thrombosis and restenosis with such a procedure. We also considered the risk of losing the important obtuse marginal branch, emerging close to the proximal aneurysmal segment, with the implantation of a covered stent. We ultimately speculated that a single, long, conventional DES, optimized with OCT guidance, would have both corrected the vascular stenosis and restored laminar blood flow as to reduce the risk of further vascular dilatation and aneurysmal thrombosis as well.

Computed tomography coronary angiography plays a pivotal role in the monitoring and diagnosis of coronary artery disease, providing a non-invasive means to evaluate presence and severity of coronary atherosclerosis. Computed tomography coronary angiography is particularly advantageous for follow-up assessments, allowing clinicians to track changes over time and adjust treatment plans as needed.[14] Our case demonstrates that coronary aneurysms can be well characterized with CTCA and are often incidentally discovered as they cause no symptoms.

The incidence of coronary aneurysm at the site of a previously implanted BVS is not defined, and little is known about the pathophysiology and evolution of these lesions. Therefore, the decision to proceed with conservative management or intervention must be tailored to the clinical conditions of the patient, the anatomy, the rapidity of growth, and the possible thrombotic burden.

Lead author biography

Antonino Micari is a fellow in cardiovascular disease at the Postgraduate School of Cardiology in Messina University Hospital. He is devoted to clinical care, multimodality imaging, and interventional cardiology.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

Acknowledgements

The authors acknowledge the contribution by Francesco Costa, Francesco Saporito, Antonio Micari, and Vittorio Virga.

Consent: Written informed consent was obtained from the patient for publication of this case report and any associated images in compliance with COPE guidelines. The patient who is being reported on is aware of the possible consequences of that reporting.

Conflict of interest: None declared.

Funding

This work was institutionally supported by the University of Messina through the APC initiative.

Data availability

The data underlying this article cannot be shared publicly for the privacy of the individual that participated in the study. The data will be shared upon reasonable request to the corresponding author.

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