Bioresorbable Vascular Scaffold: A Pioneering Solution for In-Stent Restenosis of Stent Fracture on Right Coronary Artery

Francesco Granata¹, Elisabetta Moscarella², Luigi Caliendo¹, Attilio Varricchio¹

1. Laboratory of Interventional Cardiology, Department of Cardiology, Santa Maria della Pietà Hospital, Nola, Italy.
2. Chair of Cardiology, Department of Cardio-thoracic and Respiratory Sciences – Second University of Naples, Monaldi Hospital, Naples, Italy

Corresponding author:
Francesco Granata, MD
Department of Cardiology, Santa Maria della Pietà Hospital
Via Seminario, 180035 - Nola (NA)
phone: +390815408111
Email: francesco.granata18@gmail.com

A 63-year-old male with hypertension, hyperlipemia and prior percutaneous coronary interventions (PCI) was admitted to our cath-lab for unstable angina. In his cardiac history are reported: in 2002, inferior ST-elevation myocardial infarct treated successfully by thrombolysis; in 2009, due to recurrent chest discomfort the patient underwent to PCI with implantation of two different overlapping drug-eluting stents (DES) at right coronary artery (RCA), a Xience V 4.0x15mm everolimus-eluting stent (EES) (Abbott Vascular, Santa Clara, CA) proximally and a Cypher® 3.5x33 mm sirolimus-eluting stent (SES) (Cordis Corp., Miami, FL) distally; in July 2011, a Resolute 3.0x30 mm zotarolimus-eluting stent (ZES) (Medtronic Inc., Santa Rosa, CA) was implanted at mid segment of left anterior descending (LAD) and in August 2011, a Promus Element 2.5x16 mm platinum-chromium everolimus-eluting stent (PtCr-EES) (Boston Scientific, Natick, MA) was implanted at interventricular branch of RCA for unstable angina. The coronary angiography, performed after patient provided written informed consent, showed: a focal in-stent restenosis (ISR) at proximal edge of ZES implanted in mid LAD (Fig. 1C – red arrowhead) and a proliferative ISR with thrombotic sub-occlusion at mid segment of SES previously implanted at mid RCA (Fig. 1B – red arrowhead) with fluoroscopic features of stent fracture (Fig. 1A – double green arrowhead).

Using optical coherence tomography (OCT, Ilumien, St Jude Medical, St Paul, MN) in RCA, we showed:

1. Diffuse white thrombus stratification at distal segment of RCA (Fig. 2A)
2. Evidence of semi-circumferential metallic scaffolding partially malapposed and uncovered by neointima at distal edge of stent’s fractured segment (Fig. 2B)
3. Prominent neointimal hyperplasia (MLA - minimal lumen area: 1.37 mm² – Fig. 2C ) consisting of homogeneous tissue

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Figure 1. 1A shows fluoroscopic features of stent fracture (double green arrowhead) and the absence of circumferential metallic stent struts confirming the complete displacement of the stent’s fractured segment; 1B shows proliferative ISR with thrombotic sub-occlusion at mid segment of SES previously implanted at mid RCA (red arrowhead) and a further intermediate lesion in the distal segment of the RCA; 1C shows a focal in-stent restenosis (ISR) at the proximal edge of ZES implanted in mid LAD (red arrowhead).
structure, within the stent fracture site; the absence of circumferential metallic stent struts continuity confirming the complete displacement of stent’s fractured segment - stent fracture Grade III (Fig. 1A);

4. Hypersensitivity reaction to metallic layers responsible to neointimal erosion with metallic layers uncovered at mid segment of proximal EES between 7 and 10 o’clock and conversely evidence of prominent neointimal hyperplasia consisting of homogeneous tissue structure (Fig. 2D-E-F);

Double anti-platelet therapy consisting in acetylsalicylic acid 100 mg and clopidogrel 75 mg.

After i.v. infusion of 5000 UI of heparin a JR 4 6F guiding catheter (Medtronic, Minneapolis, MN) was cannulated to RCA and Pilot 150 guidewire (Abbott vascular, Santa Clara, CA) was advanced towards posterior-lateral branch. Pre-dilatation was performed by a semi-compliant balloon TREK 3.0x18 mm (Abbott Vascular, Santa Clara, CA), following Biostream paclitaxel-eluting balloon 3.0x24 mm (Biosensors International Ltd., Singapore) was inflated at restenosis site with an unacceptable result, whereby three overlapping Absorb™ everolimus-eluting BVS 3.5x28 mm (Abbott Vascular, Santa Clara, CA) were implanted from proximal to mid segment of RCA covering completely the ISR. Post-dilatation was performed by a non-compliant balloon NC TREK 3.5x25 mm (Abbott Vascular, Santa Clara, CA). Final angiogram showed well-deployed scaffolds, and TIMI 3 distal flow without residual stenosis or dissections (Fig. 3A).

The contrast volume, fluoroscopic time, and fluoroscopic radiation dose were 215 ml, 45 min, and 6758 cGy/cm², respectively. Due to high risk of contrast-induced nephropathy, after three days, the proximal ISR of LAD was treated by two overlapping Absorb™ everolimus-eluting bioresorbable vascular scaffold (BVS) 3.0x28 mm (Abbott Vascular, Santa Clara, CA) with an optimal fluoroscopic final result in a staged PCI (Fig. 3B). The contrast volume, fluoroscopic time, and fluoroscopic radiation dose were 158 ml, 37 min, and 4576 cGy/cm², respectively. During LAD-PCI, the OCT of RCA post BVS implantation was performed; whereby, tomographic analysis disclosed a good expansion of scaffolds and a “minimal gap” in both overlapping sites with a complete fibrin gathering inside scaffold struts (Fig. 3C).

The patient was discharged in stable condition two days later. Angiographic follow up was planned at two years to evaluate the vessel remodeling and effects on stent fracture post disappearance of BVS.

The majority of stent fracture (SF) cases occurred in first generation stent (namely Cypher®) with implication of different factors attributable to vessel, stent and implantation. The main factors involving in stent fracture are: coronary location, tortuosity, calcification, stent design, strut thickness and incomplete stent apposition.

Optimal treatment strategy remains unclear with the decision to treat and the modality of treatment utilized depending on the type and severity of SF, the clinical presentation, and the presence of anatomical factors that predict possible recurrence. However, in our case the choice to treat the stent fracture with BVS was forced by need not to implant a very long additional metallic layer. Studies are also needed to investigate different interventional strategies in this rare clinical scenario of SF waiting for angiographic and tomographic follow up of our case.

Declarations of Interest

The authors declare no conflicts of interest.

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