Cardiovascular Revascularization Medicine 17 (2016) 313–317

Contents lists available at ScienceDirect

Cardiovascular Revascularization Medicine

Everolimus-eluting bioresorbable scaffold implantation for the treatment of bifurcation lesions — Implications from early clinical experience during daily practice

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ARTICLE INFO

Article history:
Received 8 February 2016
Accepted 11 March 2016

Keywords:
Coronary artery disease
Bioresorbable scaffold
Bifurcation
Percutaneous coronary intervention

ABSTRACT

Background/Purpose: The clinical performance of bioresrobable scaffolds (BRSs) in bifurcation lesion is not well investigated so far and information can currently mostly be gleaned from the results of bench testing. The present analysis evaluates the technical feasibility of BRS use in this type of lesion and its mid-term clinical outcome.
Methods/Materials: Consecutive patients with bifurcation lesions treated with at least one everolimus-eluting BRS were enrolled. Procedural success was defined as successful delivery and deployment of at least one BRS and a residual diameter stenosis ≤30%. The primary endpoint (major adverse cardiac events, MACE) included death due to cardiac cause, clinically driven percutaneous or surgical target lesion revascularization (TLR), and any myocardial infarction at the 12-month follow-up.
Results: A total of 28 patients were eligible for this evaluation. Median age was 67 (52–73) years and in 46.4% (13/28) an acute coronary syndrome was present. The procedural success rate was 97.1% (33/34). The 1-year Kaplan Meier event rates for MACE, target lesion revascularization, and scaffold thrombosis were 16.1%, 12.1%, and 8.1%, respectively. Half of these patients discontinued the antiplatelet therapy prematurely.
Conclusions: The results for BRS use in bifurcation lesions are not in line with previous studies investigating primarily simple lesions. The impaired outcomes are most likely related to the early stage of BRS use and an exacerbated risk of scaffold thrombosis due to premature discontinuation of the antiplatelet therapy. Hypothesis generated from this investigation has to be proven in further studies.
Summary: Technical feasibility of everolimus-eluting bioresorbable scaffold implantation in bifurcation lesion and the clinical mid-term outcomes were evaluated in a real world scenario. Technical success rate was high; however the clinical results were not in line with previous studies investigating primarily simple lesions. The impaired outcomes were mostly driven by an exacerbated risk of scaffold thrombosis due to premature discontinuation of the antiplatelet therapy.

1. Introduction

The implantation of bioresorbable scaffolds (BRSs) has entered the realm of routine clinical practice; these relatively novel devices provide sufficient temporary vessel support and offer various additional advantages such as late-lumen enlargement and restoration of vasomotion [1,2]. Furthermore, they are purported to resolve late and very late stent thrombosis due to degradation within 24 to 36 months. BRSs have been shown to have equivalent clinical outcome to that of drug-eluting stents (DESs) after 1 year as well as sufficient anti-restenotic efficacy in recent randomized controlled trials [3–5]. More data from all-comers investigations evaluating BRS use in a real-world scenario are forthcoming [6,7]; however, the role of BRS in specific anatomical subsets can currently mostly be gleaned from the results of bench testing [8].

Interventional treatment of bifurcational stenoses with DES is challenging and often leads to worse outcome in comparison with other lesions [9,10]. The GHOST-EU registry is the largest data collection on patients treated with BRS during daily clinical practice; within this registry 317 patients with bifurcation lesions were treated with BRS

Abbreviations: ARC, Academic Research Consortium; BRS, bioresorbable scaffold; DES, drug-eluting stents; LAD, left anterior descending coronary artery; MACE, major adverse cardiac event; OCT, optical coherence tomography; PCI, percutaneous coronary intervention; TLR, target lesion revascularization; TVF, target vessel failure; ST, scaffold thrombosis.

Conflict of interest: This work was supported by an unrestricted research grant by Abbott Vascular. Helge Möllmann, Christian Hamm, and Holger Nef received honoraria for lectures from Abbott Vascular. All other authors have no potential conflict of interest.

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http://dx.doi.org/10.1016/j.carrev.2016.03.011
1553-8389/

[6]. Results for this subgroup, however, have not yet been reported separately, and to date there is a lack of investigations that evaluate the sole application of BRS in bifurcation lesions. The present analysis was designed to assess the technical feasibility of BRS use in this type of lesion and its mid-term clinical outcome, exploring benefits and shortcomings of this novel technology in this specific anatomical subset.

2. Material and methods

2.1. Patient selection

From October 2012 consecutive patients treated with at least one BRS at the University of Giessen, Medizinische Klinik I, Department of Cardiology, Germany, were enrolled in an all-comers registry if they met all inclusion criteria and none of the exclusion criteria. Inclusion criteria were age ≥ 18 years, any evidence of myocardial ischemia on ECG, elevated myocardial enzymes, and/or angina pectoris. Furthermore, the visually estimated reference vessel diameter range was to be between 2.3 and 4.0 mm. Exclusion criteria were patients with cardiogenic shock, the presence of severe calcification and/or severe tortuosity, hypersensitivity and/or contraindications to BRS components or dual antiplatelet therapy, and pregnancy. Concomitant DES use was not a reason for exclusion. All patients were required to give written informed consent for participation. Out of this population, patients with bifurcation lesions were identified and evaluated separately. Bifurcation lesions were defined according to the European Bifurcation Club and categorized according to the Medina classification [11].

This registry was approved by the ethics board of the Justus Liebig University of Giessen, Germany (AZ: 246/12) and the study was performed according to the Declaration of Helsinki.

2.2. Device and procedure

The ABSORB BVS (Abbott Vascular, Santa Clara, California, USA) was used for percutaneous coronary intervention (PCI) in this setting. It consists of circumferential zig-zag hoops linked by bridges of poly-L-lactic acid. The device elutes a 1:1 mixture of poly-D-L-lactic acid and the anti-inflammatory drug everolimus. Radiopaque markers are localized at both ends to allow visualization. Complete resorption of the ABSORB BVS is achieved within 24 to 36 months [12].

Radial or femoral access was used for PCI. The PCI strategy was determined individually for each patient and the interventionalist made the final decision. Pre-dilatation was performed with a non-compliant balloon. Post-dilatation was not mandatory but highly recommended. If required, final kissing was performed in a “mini-kissing” technique with minimal balloon overlap. The additional use of optical coherence tomography (OCT) was left to the implanting physician's discretion. A pre-procedural loading dose of an antiplatelet agent (clopidogrel, ticagrelor, or prasugrel) was applied. During the procedure, unfractionated heparin (70 U/kg body weight) and aspirin 500 mg were administered. Post-procedural antiplatelet therapy was aspirin 100 mg indefinitely in combination with additional clopidogrel, ticagrelor, or prasugrel for 12 months, according to the patient's clinical presentation and current guidelines.

Procedural success was defined as successful delivery and deployment of at least one BRS and a residual diameter stenosis ≤30%.

2.3. In-hospital and follow-up examination

The baseline assessment included documentation of the patients' medical history and current medication, 12-lead ECG, laboratory blood analysis, and a physical examination. Follow-up for patients with at least one implanted BRS was planned for 30 days, 6 months, 12 months, and afterwards yearly for up to five years and involved either clinic visits or telephone interviews with standardized questionnaires according to the patients' preference. A routine angiographic follow-up was not planned and was performed only if clinically indicated.

2.4. Endpoints

The primary endpoint was a patient-oriented composite endpoint (major adverse cardiac events, MACE) and included death due to cardiac cause, clinically driven percutaneous or surgical target lesion revascularization (TLR), and any myocardial infarction at the 12-month follow-up. Secondary endpoints were all components of the primary endpoint, definite scaffold thrombosis (ST) according to Academic Research Consortium (ARC) criteria, target vessel myocardial infarction, procedural success, and the composite endpoint of target vessel failure (TVF), which included target vessel myocardial infarction, TLR, and cardiac death [13].

2.5. Statistical analysis

Categorical parameters are presented as counts and percentages, and continuous parameters are given as mean with standard deviation or as median with interquartile range. The Kaplan–Meier method was applied to calculate clinical events. For analysis Prism 6 (GraphPad Software, Inc., La Jolla, CA, USA) was used.

3. Results

3.1. Baseline assessment

A total of 28 patients with bifurcation lesions were identified and found to be eligible for this analysis. The majority of patients were male (85.7%, 24/28) and the median age was 67 (52–72) years. Almost half of the patients underwent catheterization due to an acute coronary syndrome (46.4%, 13/28) and the other patients were treated for stable coronary artery disease (53.6%, 15/28. Further patient characteristics are presented in Table 1.

3.2. Angiographic and procedural results

The target lesions were located predominately in the left anterior descending coronary artery (LAD) (50.0%, 14/28) and most were classified as B2/C lesions (71.4%, 20/28). Of all bifurcation lesions, 35.7% (10/28) were classified as Medina 1-1-1. In-stent restenosis was present in two lesions at the site of previously implanted metallic stents. Further angiographic characteristics are shown in Table 2.

Table 1
Baseline characteristics.

Parameter	% or mean/median	n/N or ± SD/IQR
Female gender	14.3	4/28
Age, years	65	51.75–72.75
Hypertension	78.6	22/28
Diabetes	35.7	10/28
Current smoker or history of smoking	35.7	10/28
Family history of coronary artery disease	35.7	10/28
Hypercholesterolemia	57.1	16/28
Impaired renal function	14.3	4/28
Previous myocardial infarction	25.0	7/28
Previous PCI	35.7	10/28
Previous CABG	10.7	3/28
Clinical presentation		
STEMI	14.3	4/28
NSTEMI	14.3	4/28
Unstable angina	17.6	5/28
Stable coronary artery disease	53.6	15/28

Displayed are percentages and numbers or mean and standard deviation or median and quartiles. CABG = coronary artery bypass graft, NSTEMI = non-ST elevation myocardial infarction, PCI = percutaneous coronary intervention, STEMI = ST-elevation myocardial infarction.