



Can We Keep Our Young Patients Free From Permanent Metallic Implants?



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Bioresorbable scaffolds (BRS) are appealing devices to prevent acute vessel re-occlusion after successful balloon dilatation of relevant coronary artery obstructions. Adding anti-inflammatory drugs reduces the vascular response to local injury resulting from balloon inflation and foreign material. With the proper dosage, a fast strut coverage without excessive neo-intima formation (experienced with bare metal stents) is possible. After this healing process, the metallic backbone does not have a true function anymore and clearly increases the rate of re-interventions versus balloon angioplasty only in the long run [1]. A bioresorbable device that serves this purpose for the first 3 months and afterward disappears seems ideal for patient with a long life expectancy [2]. Patients presenting with an ST-elevation myocardial infarction (STEMI) are in general younger and frequently have less extensive coronary atherosclerosis and are therefore ideal candidates for such, in general, more expensive technologies. Feasibility of the concept was first demonstrated in 2014 [3]. Yet the first generation of BRS has significant disadvantages because of the material limitations resulting in more bulky devices with unpolished, square, and dense struts with a thickness of 150 microns.

After a small series of studies in selected patients proving the bioresorption process in humans, the first larger randomized trials demonstrated the efficacy of bioresorbable devices to minimize target lesion failure. Yet, based on the devices' inner structural fragility, the protocols of these studies advocated gentle implantation. This resulted in lower acute gain and larger remaining diameter stenosis for BRS than with permanent metallic stents immediately after implantation and during early follow-up. Pooled analysis from larger randomized and propensity-matched series subsequently showed an increased acute and early scaffold thrombosis rate, which was frequently explained by this suboptimal implantation result and the bulkiness of the device.

Realizing this issue, an updated implantation strategy for the Absorb bioresorbable vascular scaffold (BVS) has been advocated. In a study

published in this issue of *Cardiovascular Revascularization Medicine*, Ielasi et al. implemented such a strategy in a multicenter registry (BVS-STEMI STRATEGY-IT) focusing on young patients presenting with first-time myocardial infarction (MI) [4]. Only a minority (19%) of these patients required a regular metallic drug-eluting stent (DES) in a staged procedure for a significant non-culprit lesion, while 81% were treated without any metallic stent implantation. Pre-dilatation according to the suggested implantation strategy was widely used (90.7%) yet only 38.4% with classical full balloon dilatation using a 1:1 balloon-to-artery diameter ratio. Post-dilatation usage was even higher (92.7%), frequently with balloons larger than the nominal diameter of the scaffold (56%) and high-pressure inflation (≥ 16 atm; 41.2% of the cases). Using this strategy, the results as published in this issue of *CRM* are extremely encouraging. Only 3 patients (0.6%) experienced a device-oriented clinical endpoint (DOCE) at 30 days and another 3 patients at up to one year (1-year DOCE 1.2%). More intriguing is the single definite scaffold thrombosis and 1 probable (unexplained death) thrombosis. It seems that with this new implantation strategy, the investigators were able to obtain results matching current DES standards, with 1-year thrombosis rate $< 1\%$. However, the impact of patient and lesion selection on the improved results is unclear. Indeed, only 16.9% of patients were selected for BVS, mostly in large vessels (just 10% using at least 1 small BVS of 2.5 mm diameter). Additionally, nearly all patients remained on potent (ticagrelor or prasugrel) dual antiplatelet therapy for 12 months as recommended by the protocol. As these points also improve results in regular DES, no definite conclusion without a randomized trial can be made. The results of ABSORB IV demonstrated the effect of patient and lesion selection besides the improved implantation protocol by reducing event rates compared to ABSORB III both for BVS and DES, still with a disadvantage for the BVS. Recently, the larger (N=1670) randomized COMPARE-ABSORB study (also using a similar dedicated implantation) failed to minimize the disadvantage of the bulkier device in a more complex lesion subset, with a remaining

significant high rate of definite or probable device thrombosis (2.0 vs. 0.6% for BVS vs. DES) [5].

Is the correct implantation technique sufficient to correct for differences in device characteristics? Detailed analysis of the ABSORB Japan trial [6] previously demonstrated that strut embedment does not improve with balloon sizing and inflation pressure. Only the underlying plaque morphology had an impact, with best embedment in fibroatheroma and least in fibrocalcific plaque. This could partially explain the impressive results of the BVS- STEMI STRATEGY-IT, where strut embedment might have been better compared to the more complex lesions in COMPARE-ABSORB.

Nevertheless, post-implantation strut protrusion is more related to strut thickness [7] and strut design (quadratic structure vs. oval) [8]. The final impact of the device on post-implantation shear stress is furthermore dependent on strut distance and, again, strut design. With this knowledge, it seems impossible with current BRS to obtain clinical outcomes similar to current thin-strut DES, with the new target being DES with ultrathin struts (<90 µm). Yet, with ongoing technical development like the Fantom scaffold (Reva Medical, San Diego, California), with strut thickness that ranges from 95 to 115 µm, ArterioSorb (Arterius, Leeds, UK), with a strut thickness of 95 µm and Mirage BRS (ManLi Cardiology, Singapore) with more oval struts, better results are expected, especially in fibroatheromic plaque of STEMI. The magnesium BRS also has fewer quadratic struts and is potentially easier to embed and also less flow disturbing.

In the meantime, in our young patients with a long life expectancy and in whom we might want to avoid permanent metallic implants, a proper diagnosis of the underlying cause of the acute coronary syndrome may be crucial. In case of erosions with fresh thrombus identified with optical coherence tomography, thrombus aspiration and anti-thrombotic treatment are effective strategies, as demonstrated in the EROSION study [9]. Alternatively, in patients with classic plaque rupture, initial balloon dilatation might give sufficient lesion reduction,

while balloon-assisted local drug delivery might preserve the obtained result during the healing process, avoiding the deployment of metal struts, as demonstrated by the recent REVELATION study [10].

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