EDITORIAL COMMENT

**Bioresorbable Drug-Eluting Stents**

No Pain, No Gain*

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Although current-generation metallic-backbone drug-eluting stents are extremely safe and highly efficacious in preventing restenosis, they exhibit a small but steady rate of failure in the years following device implantation (1,2). Recent insights from autopsy and intravascular imaging studies suggest that many of these events are due to an accelerated form of atherosclerosis that develops inside the stent (3). This provides rationale for the development of bioresorbable stents, which break down and disappear once their early scaffolding function has been served.

Two approaches to the development of bioresorbable stents appear most promising. The first approach uses backbones constructed from poly-lactic acid. Two devices leveraging this technology have CE mark approval for use in Europe, the Absorb bioresorbable vascular scaffold (Abbott Vascular, Santa Clara, California) and the DESolve stent (Elixir Medical Corporation, Sunnyvale, California). In addition, the Circulatory System Devices Advisory Panel of the U.S. Food and Drug Administration recently voted to support an application for use of the Absorb stent in the United States (4). The second approach uses magnesium stent backbones, which degrade somewhat more rapidly than lactic acid stents. One such device is expected to receive CE mark approval this year (Magmaris, Biotronik, Bülach, Switzerland).

Because of differences in the requirements of regulatory authorities in Europe and the United States, patients and physicians in Europe often have access to novel stent devices prior to the availability of randomized controlled trial data (5). Indeed, bioresorbable stents have been approved for use in Europe for more than 5 years. During this time, data from registries have shown generally favorable results, though evidence suggests a slight increase in the rate of stent thrombosis, especially within the first 30 days after implantation (6–8).

In this issue of *JACC: Cardiovascular Interventions*, Sotomi et al. (9) report an interesting analysis from the ABSORB II trial, examining intravascular ultrasound pull backs and quantitative coronary angiography at the time of stent implantation. In this trial, 501 patients were randomly allocated to treatment with bioresorbable Absorb stents or conventional metallic everolimus-eluting stents (EES) (Xience, Abbott Vascular). An interim analysis showed broadly comparable rates of clinical events between the 2 devices at 1 year (10), and primary endpoint results at 3-year follow-up are expected later this year. In the present report, data from 445 patients with intravascular ultrasound imaging pre- and post-intervention were analyzed. The main result was that acute gain (3.46 ± 1.35 mm² vs. 4.27 ± 1.46 mm²; p < 0.001) and minimal luminal area after the procedure (5.55 ± 1.46 mm² vs. 6.40 ± 1.68 mm²; p < 0.001) were lower with the Absorb stent. This was consistent with the angiographic analysis of this subgroup, as well as with the analysis of the entire treated cohort reported previously (acute gain: 1.15 ± 0.38 mm vs. 1.46 ± 0.38 mm; p < 0.001; minimal luminal diameter post-procedure: 2.22 ± 0.33 mm vs. 2.50 ± 0.33 mm; p < 0.001) (10). These differences were attributable to differences measured...
immediately after stent implantation; in patients who underwent post-dilation (approximately 60% of all enrolled patients), similar degrees of additional acute gain were seen in both groups.

A summary of differences in minimal luminal diameter after the procedure from each of 6 published randomized trials comparing the Absorb stent with metallic EES is shown in Figure 1 (10–15). The results are broadly consistent across studies, with mean minimal luminal diameter consistently favoring the conventional metallic stent over the Absorb stent. However, the magnitude of difference is relatively small, ranging from a mean difference of 0.00 to 0.28 mm. Moreover, in the trials incorporating planned angiographic follow-up between 6 and 13 months after intervention, the differences in minimal luminal diameter immediately after the procedure seem to contribute importantly to the small differences in antirestenotic efficacy observed between the stents at follow-up (Figure 1) (11–14).

These observations are important for 2 reasons. First, randomized trials comparing the Absorb stent with metallic EES show a 2-fold higher rate of stent thrombosis with the Absorb stent and a time-dependent increase in risk that is greatest between 1 and 30 days after stenting (16). Although the reasons for this are likely multifactorial, the observations in relation to differential acute gain provide some mechanistic insight: the degree of residual stenosis in the stented segment is a well-known risk factor for subsequent stent thrombosis (17). Second, the angiographic antirestenotic efficacy of the Absorb stent is marginally inferior to that of metallic EES (16). This analysis suggests that the lower acute gain with the Absorb stent, rather than differences in subsequent late loss, accounts for much of this difference.

In terms of implications for clinical practice, the message seems clear. With current-generation devices, the operator must ensure that every additional effort is made to maximize acute gain with the Absorb stent. This means careful selection of lesions most likely to result in optimal scaffold expansion, meticulous attention to detail with respect to lesion preparation and post-dilation, and liberal use of intravascular imaging to identify and target suboptimal deployment. One practical approach is to use specific implantation protocols to optimize deployment practices. Although this approach is more time consuming and cost intensive, and will not be suitable for every catheterization laboratory, the benefits are likely to be real. Indeed, preliminary observations suggest a detectable improvement in clinical outcomes with such an approach (7).

Finally, at present, the additional pain associated with the implantation of current-generation bioresorbable stents must be borne by the operator. As we look to the future, however, manufacturers will shoulder more of this burden, with iterative development of this still young technology. Ultimately, the availability of new devices with good acute results and similar ease of use to current-generation drug-eluting stents will increase the acceptance of these stents in years to come.

REFERENCES


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