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EDITORIAL COMMENT

The Artisan Approach for Stenting Bifurcation Lesions*

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Percutaneous coronary intervention (PCI) on coronary bifurcations has always been associated with imaginative and innovative techniques. Recently this innovation has resulted in the development of lesion-specific devices such as dedicated bifurcation stents. However, since the advent of PCI, treating the bifurcation has been renowned as being more complex and technically demanding than nonbifurcation lesions. When Andreas Gruentzig introduced kissing balloon coronary angioplasty in 1981 (1), this procedure required two 8-F guiding catheters. We have moved far from these needs, and we are now able to perform complex stenting of bifurcation lesions with a 6-F guiding catheter. Despite the fact that the current mantra in bifurcation PCI is "simpler is better" and "less is more," we should not let this restrict us from examining new techniques that might be technically more challenging but might carry a better outcome if properly used. In this issue of *JACC: Cardiovascular Interventions*, a group of highly skilled Japanese operators describe a novel technique for optimizing the outcomes of bifurcation PCI (2).

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Skeptics might question why we need yet another bifurcation technique? The answer lies with the ostium of the side branch (SB) for which we have yet to define an optimal solution. The ostium of the SB is the commonest site of restenosis even after the provisional approach (3). The most frequently proposed mechanism is that the SB ostium is not fully covered and scaffolded, and the stent is usually unfavorably distorted. As a result, a number of techniques for stenting both branches of the bifurcation have been suggested. T-stenting, which is the simplest of these, has the disadvantage that with angles ≤70°, there is almost always incomplete coverage of the SB ostium. As a result, the crush and culotte techniques have been proposed, because they both provide excellent coverage of the SB ostium and carina (4). However, these techniques are limited by their complexity and concerns that the multiple stent layers might delay re-endothelialization after drug-eluting stent (DES) implantation. With both techniques the stent on the SB is deformed and does not support the ostium of the vessel on the basis of optimal stent geometry. The most recently proposed technique has been the T And Protrusion (TAP) technique, which is a modification of T-stenting where the SB stent protrudes slightly into the main branch (MB) to ensure complete coverage of the ostium without deformation of the stent or malapposed struts. However, even with all these innovative techniques and the introduction of DES, restenosis at the SB ostium remains the most important reason for repeat revascularization on the bifurcation. The probable mechanisms include focal stent underexpansion at the ostium, inadequate ostial scaffolding, and uneven drug distribution.

The technique of "flower petal" stenting in brief involves implanting a stent in the SB with 1 strut protruding into the MB; the protruding strut closest to the carina is wired and dilated to create a larger strut or "flower petal"; this protruding petal is then flattened and plastered down over the carina with a series of MB inflations including a MB stent and kissing balloon inflations; thus ensuring complete ostial coverage and scaffolding (2). The most challenging part of this technique is wiring a single strut close to the carina, and even for these expert operators, this required intravascular ultrasound guidance and was not always successful. The proponents modified the technique to allow ex vivo wiring of the proximal strut and subsequent balloon insertion into this strut. This approach needs partial inflation of the proximal segment of the stent, performed before stent insertion in the guiding catheter (see Fig. 2 of Kinoshita et al. [2]). By doing this they created a bulkier dual-wire and balloon system that might suffer from the shortcomings of similar dedicated devices: wire wrap, wire bias, and atheroma that might prevent advancement of the device. In spite of that, a 6-F guide catheter is suitable for this approach. Most of the limitations of "flower petal stenting" can be overcome by applying this technique mainly in bifurcation lesions located in the distal left main. This view is confirmed because 28 of the 34 lesions treated were located in the distal left main/left anterior descending arteries. The authors were successful in deploying stents in all lesions, and final kissing balloon inflation was always applied. This new approach has many similarities to the TAP or mini-crush techniques but gives a very controlled protrusion in the MB; and with the final implant of the MB stent and kissing inflation, any residual metal is flattened in an even geometrical fashion around the ostium of the SB.

The obvious question concerning this technique is whether the stent deformation impairs optimal scaffolding with an increase in stent recoil and whether polymer

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damage can be considered minor. The authors performed bench top testing, multislice computed tomography, intravascular ultrasound, and endoscopy, which all confirmed that the carina was covered with metal and that there was good ostial stent expansion and no protrusion of struts from the SB into the MB. Electron microscopy confirmed that there was only minimal polymer damage in the overlapping portion of the SB stent. Clinical results in the 33 patients treated with this technique were promising. There were no periprocedural complications. Angiographic follow-up in 26 of 34 lesions showed only 2 cases of restenosis that occurred after "reverse flower petal" stenting (i.e., when stenting the SB after the MB). This finding might suggest that the MB stent prevents adequate ostial expansion and coverage of the SB stent.

It would thus seem that the authors have satisfied all the prerequisites for proposing a new technique: bench top testing, and a clinical pilot study in an acceptable cohort of varying complexity. The authors should be congratulated for their ingenuity and inventiveness in attempting to use standard PCI materials and modifying them to create a bifurcation-specific device. By flaring the SB stent to completely cover the ostium, it would seem that the authors created a dedicated stent very similar to the Cappella Sideguard (Cappella, Inc., Auburndale, Massachusetts). The Sideguard is a self-expanding nitinol SB stent with a trumpet-shaped design that optimizes scaffolding and results in complete coverage of the SB ostium (5). The Sideguard belongs to a group of SB-specific dedicated stents that also includes the Tryton (Tryton Medical, Newton, Massachusetts) and Biguard (Lepu Medical, Ltd., Beijing, China). These stents were designed with the aim of ensuring optimal scaffolding and coverage of the SB ostium while facilitating performance of 2 stent techniques. The advantage of the technique proposed by Kinoshita et al. (2) is that this approach gives the opportunity to use a DES on the SB. The major drawback of SB-specific dedicated stents is that they commit the operator to treatment of both branches of the bifurcation from the outset. Similarly, "flower petal" stenting commits the operator to 2 stents and possibly a longer and more complex procedure. In our view, this characteristic should not necessarily be seen as a limitation, because there are many bifurcation lesions where the need to implant 2 stents seems clear from the very beginning of the procedure. This is a particular necessity in distal left main bifurcations, where more than one-half of the lesions will need implantation of 2 stents (6).

The current study gives further evidence that adequate scaffolding and uniform drug distribution at the ostium might reduce restenosis. It is interesting to see that some of the new dedicated stents are moving in the direction of this pioneering work, and it is rewarding that the initial data demonstrate optimal angiographic and clinical outcomes.

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