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EDITORIAL COMMENT

Kissing, Snugging, or "Potting"?

The Evolution of Stenting Techniques in Bifurcations*

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The success of the English language in the modern world is strictly linked with its ability to adapt itself to the development of new habits and behaviors. Purists of the language may despise neologisms but they are unavoidable consequences of this adaptation process. In this issue of *JACC: Cardiovascular Interventions*, Derimay et al. (1) give us good reasons to replace familiar words such as *kissing* or *snugging* with a new word that has nothing to do with cannabis or pottery and a lot to do with modern interventional cardiology. They summarize well the challenges of stent implantation in

SEE PAGE 1397

bifurcations: ensure apposition of a straight cylinder in a 2-step vascular structure with the diameter of the distal segment equal to two-thirds on average of the proximal segment diameter and avoid that metal or polymer struts across the origin of the side branch disrupt flow (1). We may argue that no large randomized trials have unequivocally confirmed the benefit of any of these 2 maneuvers but it is undeniable that bifurcations have higher risk of stent thrombosis and restenosis. Underexpansion and malappostion justified by these peculiar characteristics appear the most obvious mechanisms. Systematic kissing balloon dilation has not provided clinical benefit compared with the simple deployment across the side branch origin in provisional stenting trials (2) but the technique used was far more primitive than the re-proximal optimization technique (POT) proposed by Derimay et al. (1) and advantages were seen when a second stent was required in the side branch. The pitfalls of conventional kissing were known also in the metallic stent era. Open struts toward the side branch preventing the deformation of the main vessel stent during inflation are the goal of kissing inflation. You may achieve the same goal and obtain a more circular and adequate expansion of the proximal stent with sequential dilation, as shown in previous in vitro studies of metallic stents by Foin et al. (3). Still, in metallic stents there is no real drawback in using kissing first, and then complete treatment with a larger proximal balloon (4).

The introduction of less forgiving bioresorbable stents with narrow margins of adaptability to expansion and deformation has obliged operators to reconsider the classical bifurcational stenting technique and adapt it to the specific characteristics of these promising new devices. The typical biovascular scaffold (BVS) strut is 160 μm thick and 190 μm wide, twice the dimension of current metallic drug-eluting stent (DES). The results of side branch (SB) strategies with thin-strut metallic DES are therefore not simply transferable to BVS. Serial optical coherence tomography studies have shown that struts across the SB ostium are triggers for the development of large bridges of tissue, persistent also after polymer reabsorption. We learned from bench models that the tolerance of polymers exceeds by only little the narrow specifications of the manufacturers and overexpansion must be done with low compliance balloons within the tolerance limits (5). We also learned that unpredictable responses may follow kissing balloon dilation. Rupture of the ostial cell appears a less dramatic problem than disruption of the scaffold in the main vessel, causing loss of mechanical integrity with recoil and gross malapposition

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with struts floating inside the lumen (6,7). Avoiding excessive proximal protrusion of the side branch balloon (snugging) has been empirically proposed to minimize overlapping but there is no convincing experimental validation of a method that appears difficult to reproduce. This study convincingly shows that there is a better and more predictable way to limit ostial obstruction with SB dilation using a single balloon and subsequent correction of the secondary deformation of the main vessel scaffold with a balloon matching the diameter of the proximal vessel positioned with the marker at the distal end of the side branch ostium.

Despite the attention of Derimay et al. (1) to develop a model matching size and geometry of the most frequent bifurcations in a material mimicking thickness and resistance of the vessel wall, there are many reasons to believe the process can be less smooth and successful in true arteries with complex plaques. What about inadvertent recrossing with BVS? Could the dilation of the SB through a side cell increase stress on the BVS strut? In metallic stents, we learned from bench model and in vivo intravascular imaging that location of recrossing is difficult to control but greatly affect success of SB optimization and resulting flow toward the SB (8). In theory meticulous preparation of the lesion should allow easy expansion of the BVS but Rotablator (Boston Scientific, Natick, Massachusetts), kissing or scoring balloons, and high-pressure pre-dilation are helpful but not always sufficient to solve the problem. Post-dilation at high pressure is a cornerstone of the modern technique of BVS implantation and appears to reduce the risk of thrombosis (9). For this step in the main vessel you will need short balloons matching the lumen diameter, ideally selected with intravascular ultrasound or optical coherence tomography that can also check the result and the need of further post-dilation. With this last method it has been shown that, as long as the balloon diameter do not exceed the recommendation, pressures up to 40 atm are safe in BVS (10). This step is missing in the Derimay et al. (1) algorithm that also proposes a fixed low pressure for the SB dilation. What to do if the balloon remains grossly indented at the ostium? Is it safe to use high pressure? Should we routinely pre-dilate also the SB at high pressure before BVS deployment? The current recommendations of the European Bifurcations Club discourage pre-dilation of the SB for provisional stenting (11,12).

The second recommendation with metallic stents not applied by most operators when using BVS in bifurcations is to use a BVS diameter matching the distal vessel. To increase the flexibility in the post-dilation process a 3.5 BVS would be preferred in a left anterior descending coronary artery with a diameter distal to the bifurcation of 3.0 mm. This may avoid the need of a first POT before SB recrossing and dilation.

Bench models have greatly expanded our understanding of the response of stents in bifurcations and allowed fine-tuning of techniques of provisional and 2-vessel stenting. At the end, however, real-life observations are needed.

The question is whether the current generation of BVS is truly ideal for this application or whether it is preferable to wait for prostheses with greater polymer adaptability and less recoil, another interesting surprising finding of this experimental series, at odds with the current belief and expectation. While bench results in metallic stents are mostly transferrable between platforms, the same will not necessary be true in the world of bioresorbable stents (BRS) as material and expandability is very specific and observations with BVS may not apply to other BRS (13,14).

Kissing balloon dilation is a catchy unforgettable name strictly linked to the black-and-white images of masterpieces of the French cinema shown by Lefevre and Louvard, the first proposers of bench models. "Potting" is less inspiring and it is difficult to find an iconic evocative scene for this concept in today's Hollywood movies but it is probably more effective and should be used, with metallic or biodegradable stents, in all bifurcations.

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