Improving the Success to Recross into the Side Branch After Mini-Crush Technique for Bifurcation Lesions

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Despite considerable progress in the field of interventional cardiology, percutaneous treatment of coronary bifurcations continues to be associated with a lower procedural success rate and a higher incidence of complications, target lesion revascularization (TLR) and stent thrombosis. The provisional approach has become widely accepted as the default technique in the majority of bifurcations. However, stent implantation on both branches of the bifurcations is still required in 15%-30% of cases.[1-3] The decision to perform double stenting is predominantly dictated by the side branch (SB) and it should generally be reserved for cases where SBs are relatively large in diameter (>2.5 mm) with a vast territory of distribution, severe disease extending well beyond the ostium, and with an unfavorable anatomy for rewiring after main branch (MB) stenting.

The "mini-crush" is one of various techniques used to implant stents on both branches of a coronary bifurcation lesion and was designed to provide complete coverage of the ostium of the SB while minimizing the length of the crushed segment.[4,5] The details of this technique have been described.[6,7] A key element of this technique is the performance of a two-step kissing balloon inflation (TS-FKB).[8] It is well proven in this setting that the TS-FKB step is mandatory in order to avoid stent distortion and improve short- and long-term angiographic, procedural, and clinical event-free outcomes.[7,9] In order to perform this important maneuver, the operator needs to recross with a wire into the SB.

In this issue of *the Journal of Invasive Cardiology*, Elbasan et al[10] investigated the factors that contributed to the failure of TS-FKB in 173 consecutive patients treated with mini-crush stenting. Kissing inflation could be performed in 88.4% of patients. A significantly higher angle between the proximal and distal MB and a higher calcification burden of the coronary lesions were observed in patients with failure. Multivariate logistic regression analysis showed that only the angle between the proximal and distal MB was an independent predictor of failure of the TS-FKB and the receiver operating characteristic curve analysis of this angle showed a cut-off value of 167° for predicting failure with a sensitivity of 86.7% and a specificity of 89.2% (area under the curve, 0.931; $P<.001$). According to the authors, a possible explanation of these findings is that the stent strut cell at the SB ostium is relatively narrowed in patients with a wider angle between the proximal and distal MB and advancement of a balloon into the SB is extremely difficult. However, patients with a lower angle have relatively larger strut cell at the SB ostium with easier advancement of balloons into the SB to facilitate recrossing. This aspect is of imperative importance considering that this and previous studies have shown that the incidence of failure of SB recross after crush technique is not negligible (≈15-20%)[10,11] and it is associated with significantly higher adverse event rates.[12] Furthermore the sub analysis of the CACTUS (Coronary Bifurcations: Application of the Crushing Technique Using Sirolimus-Eluting Stents) trial showed that patients with successful kissing inflation have lower MACE and better angiographic results.[2]

Several technical strategies may increase the possibility of performing an effective SB recrossing. The choice of the guidewire is of paramount importance. The first choice is the Frontline guidewire (Boston Scientific), with a soft tip and a curve of radius greater than the diameter of the MB. In case of failure, the use of more supportive and steerable wires such as the Rinato/Prowater wire (Asahi Intecc) navigating in a precise direction while maintaining the tip in a straight configuration guarantees a successful passage. In difficult situations, we have also successfully used the Intermediate guidewire (Asahi Intecc). We try to minimize the usage of hydrophilic wires due to the risk of subintimal passage. In rare situations, the operator needs to increase the tip strength by switching to Miracle 3/4.5 gm wires (Asahi Intecc).[7] A very important step to improve the success of SB recrossing is to perform the proximal optimization technique (POT) by inflating a short NC balloon on the proximal part of the MB stent to optimize the expansion of the malapposed struts (especially when we choose our MB stent according to the distal MB reference diameter).[13] The POT maneuver will ensure that the stent is well apposed in the proximal MB, will further modify the carina, and will facilitate a "distal" cross to the SB as opposed to a proximal one. There are circumstances where, despite successful wire recrossing, the balloon has difficulties advancing into the SB. Repeated inflations of the balloon, in the most possible advanced position toward the SB, are frequently helpful to gain the desirable more distal position.[7] It is of imperative importance to always perform a TS-FKB. After implanting both stents, first the SB stent is dilated toward the SB with an appropriately sized balloon with respect to the diameter of this branch and inflated at high pressure (16 atm or more), then FKB with a second balloon in the MB with simultaneous inflation to a pressure of about 8-14 atm in both balloons.

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The practical value of the study by Elbasan et al is to make the operator alerted about situations where extra work needs to be employed in order to recross into the SB.[10] It may be wise, in the case of a very wide angle between the proximal and distal MB, not to utilize the "mini-crush" technique. Another approach, when faced with a wide-angle bifurcation, could be the use of the DK-crush technique (dual kissing-balloon inflations) described by Chen et al.[14] This technique is a modification of the standard crush technique. In the DK-crush, balloon kissing inflation is performed twice: first after the SB stent is crushed by the balloon in the MB and then the routine FKB at the end of the procedure. The DK-CRUSH2 trial randomized 372 bifurcations to treatment with either the DK-crush technique or provisional stenting.[15] Interestingly, this is the first and only randomized trial to suggest that double stenting may be superior to provisional stenting and associated with a lower rate of restenosis and repeat revascularization.

The fact that the operator is familiar with different solutions to tackle problems makes the result of the intervention more predictable and the procedure is performed in a more smooth fashion.

As frequently said, it is better to know difficulties at the beginning of a procedure rather that face unexpected problems.

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