

## Predilation in Coronary Bifurcation Lesions: Must We Adhere to Einstein's Reductionism?

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*"Everything should be made as simple  
as possible, but not simpler."*

*Albert Einstein (1879-1955)*

Percutaneous treatment of complex coronary bifurcation lesions is a constant challenge for the interventionist. Bifurcation lesions are frequent, representing 15% to 20% of all percutaneous coronary interventions (PCIs). Their treatment is associated with lower procedural success and a higher incidence of periprocedural myocardial infarction, stent thrombosis and in-stent restenosis, as well as a higher procedure cost compared with the treatment of lesions not located in bifurcations. Initially, our knowledge was very sparse regarding the techniques and steps that are required to successfully perform PCI in coronary bifurcation lesions.

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That has changed. Thanks to drug-eluting stents (DES) and their obviously lower rate of in-stent restenosis, as well as the improvement in stent materials and design, it is easier to study and address complex challenges in bifurcations. That, in turn, resulted in well-conducted and randomised clinical trials in bifurcations, such as the NORDIC<sup>1-3</sup> clinical trials and the CACTUS<sup>4</sup> and BBC ONE<sup>5</sup> studies, among others.<sup>6,7</sup> In addition, meetings and organisations have been dedicated to addressing bifurcations, such as the European Bifurcation Club and the Asian Bifurcation Club, aiming to guide this area of knowledge and address outstanding issues. Likewise, many dedicated stents have been developed for this type of lesion, such as Axxess, Tryton, Xience SBA, and Nile, which may offer better results.

Consequently, some consensus regarding the use of PCI in coronary bifurcation lesions have emerged

during recent years. To date, the provisional strategy using DES has been the technique of choice wherever possible and consists of stenting in the main vessel, whereas stent implantation in the side branch is performed only when necessary. This consensus is based on large randomised clinical trials reporting that the complex approach with systematic implantation of 2 stents in both branches, main and side, was not better than the provisional strategy. The provisional strategy is simpler regarding major adverse cardiovascular events and resulted in a significant increase in the procedural and fluoroscopy time duration, a larger amount of contrast used and an increased release of biomarkers related to the procedure.<sup>1,5,6</sup> Therefore, our stenting technique in bifurcations should remain as simple as possible. It is still unclear whether the procedure should be finalised using kissing-balloon dilation. Although the strategies of stenting in the main vessel, with or without kissing-balloon dilation, have been associated with similar outcomes, kissing-balloon dilation in the angiography, especially in patients with true bifurcation lesions, has decreased side-branch restenosis from 20% to 7.6%.<sup>3</sup> Thus, we believe that the kissing-balloon dilation should be used in cases where the lesion remains angiographically significant (> 75%) in the side branch after stenting of the main vessel.<sup>8</sup>

Another subject for debate regarding stenting in bifurcations refers to the need to perform systematic side-branch predilation, especially if it has a significant and long lesion (> 5 mm). This issue is addressed in the article by Costa et al.,<sup>9</sup> published in this issue of the **Revista Brasileira de Cardiologia Invasiva**. This study is a subanalysis of a prospective, randomised trial comparing the efficacy of the provisional technique *versus* two-stent implantation in 59 patients with a single *de novo* lesion in the coronary artery bifurcation, compromising the main vessel and the side branch (called 'true bifurcation lesions', lesions 1.1.1, 1.0.1 or 0.1.1, according

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to Medina classification) with the side-branch lesion extending > 5 mm beyond the ostium (or true complex bifurcation lesions). In this clinical trial, side-branch lesions involved a long segment, with a mean length of 9.9 mm to 12.6 mm, significantly longer compared with the mean length of side-branch lesions in previous trials (5.7 mm to 7.5 mm).<sup>1-4</sup> Costa et al.<sup>9</sup> should therefore be congratulated for the careful recruitment of patients with severe and complex bifurcation lesions and for the accurate description of these lesions. In this analysis, the results of systematic side-branch predilation were reported in all cases. Of the 59 patients, 5 (8.5%) did not have successful side-branch predilation, defined as dissection, TIMI flow < 3 or residual stenosis > 50%. These 5 patients were subsequently excluded from the randomised study where treatment was decided at the surgeon's discretion. In 4 of these 5 patients (80%), the failure was due to dissection successfully treated with the two-stent strategy, whereas one of them had significant residual stenosis in a calcified lesion that could not be treated. There were no significant differences in terms of lesion extension, (the mean lesion diameter or stenosis diameter between the groups with successful vs. unsuccessful predilation), although the study most likely had little power to detect such differences. A multivariate analysis identified the severity of the side-branch stenosis diameter as a predictor of predilation failure in this branch. Costa et al.<sup>9</sup> have therefore demonstrated a dilemma: the more severe stenoses would benefit the most from predilation, but they also have the greatest potential for failure after predilation.

The non-randomised nature of side-branch predilation and the small number of patients in the study by Costa et al.<sup>9</sup> may prevent more consistent conclusions regarding the practice in daily routine. Other randomised studies are certainly needed. However, although the side-branch lesions were smaller in the NORDIC study when compared with the study by Costa et al.<sup>9</sup> (mean length of lesions of 6 mm to 6.4 mm vs. 9.9 mm to 12.6 mm, respectively), the prerequisite in the NORDIC study to prevent pretreatment with a conventional balloon or a cutting balloon of the segments not covered by the stent resulted in lower cross-over from the simpler technique to the more complex one in the main vessel and side-branch stenting in 4.3% of patients. In the study by Costa et al.,<sup>9</sup> the predilation resulted in a complex (or unsuccessful) stent implant in 8.5% of cases. The rate of cross-over in the randomised part of this trial, in addition to these 8.5%, is still unknown. In the CACTUS study, for instance, where the side-branch predilation was performed in 90.8% of patients, the rate of cross-over from a simple provisional implant to complex crush stenting was 31%.<sup>4</sup> Therefore, it appears that side-branch predilation has implications. Similarly, bifurcation registries, such as TULIPE, demonstrated that side-branch predilation is not a

predictor for successful recrossing of the guidewire through the stent structure or angiographic success of the side branch.<sup>10</sup>

We do not have enough data to advocate routine side-branch predilation when the intention is to use the provisional technique of stenting in bifurcation lesions. Maybe we could adhere to Einstein's reductionism ('Everything should be made as simple as possible...'), simplifying our procedure and avoiding predilation whenever possible. However, the procedure should not be simplified to the extreme ('...but not simpler') but performed in such a way that, if the side branch is compromised (TIMI flow < 3 in side branch  $\geq$  2.5 mm, fractional reserve flow < 0.75, residual stenosis > 75%, dissection) before implanting a stent, side-branch predilation may be performed to restore adequate flow, taking into account that the two-stent strategy may be necessary. This is not based on guidelines, which will be defined in future studies. As Einstein also suggested, 'The important thing is not to stop questioning'.

## CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

## REFERENCES

1. Steigen TK, Maeng M, Wiseth R, Erglis A, Kumsars I, Narbutė I, et al. Randomized study on simple versus complex stenting of coronary artery bifurcation lesions: the Nordic bifurcation study. *Circulation*. 2006;114(18):1955-61.
2. Erglis A, Kumsars I, Niemela M, Kervinen K, Maeng M, Lassen JF, et al. Randomized comparison of coronary bifurcation stenting with the crush versus the culotte technique using sirolimus eluting stents: the Nordic stent technique study. *Circ Cardiovasc Interv*. 2009;2(1):27-34.
3. Niemela M, Kervinen K, Erglis A, Holm NR, Maeng M, Christiansen EH, et al. Randomized comparison of final kissing balloon dilatation versus no final kissing balloon dilatation in patients with coronary bifurcation lesions treated with main vessel stenting: the Nordic-Baltic Bifurcation Study III. *Circulation*. 2011;123(1):79-86.
4. Colombo A, Bramucci E, Sacca S, Violini R, Lettieri C, Zanini R, et al. Randomized study of the crush technique versus provisional side-branch stenting in true coronary bifurcations: the CACTUS (Coronary Bifurcations: Application of the Crushing Technique Using Sirolimus-Eluting Stents) Study. *Circulation*. 2009;119(1):71-8.
5. Hildick-Smith D, de Belder AJ, Cooter N, Curzen NP, Clayton TC, Oldroyd KG, et al. Randomized trial of simple versus complex drug-eluting stenting for bifurcation lesions: the British Bifurcation Coronary Study: old, new, and evolving strategies. *Circulation*. 2010;121(10):1235-43.
6. Ferenc M, Gick M, Kienzle RP, Bestehorn HP, Werner KD, Comberg T, et al. Randomized trial on routine vs. provisional T-stenting in the treatment of de novo coronary bifurcation lesions. *Eur Heart J*. 2008;29(23):2859-67.

7. Colombo A, Moses JW, Morice MC, Ludwig J, Holmes DR Jr, Spanos V, et al. Randomized study to evaluate sirolimus-eluting stents implanted at coronary bifurcation lesions. *Circulation*. 2004;109(10):1244-9.
8. Hildick-Smith D, Lassen JF, Albiero R, Albiero R, Lefevre T, Darremont O, et al. Consensus from the 5th European Bifurcation Club meeting. *EuroIntervention*. 2010;6(1):34-8.
9. Costa RA, Feres F, Staico R, Costa Jr JR, Siqueira D, Tanajura LF, et al. Impacto da pré-dilatação do ramo lateral no procedimento de intervenção coronária percutânea em lesões de bifurcação coronária complexas. *Rev Bras Cardiol Invasiva*. 2012;20(2):125-32.
10. Brunel P, Lefevre T, Darremont O, Louvard Y. Provisional T-stenting and kissing balloon in the treatment of coronary bifurcation lesions: results of the French multicenter "TULIPE" study. *Catheter Cardiovasc Interv*. 2006;68(1):67-73.