The Smart Strategy for Side Branch Intervention
Still the Less, the Better?*
Bon-Kwon Koo, MD, PhD

A bifurcation lesion is still one of the challenging lesion subsets in the field of percutaneous coronary intervention (PCI). Even though recent studies have provided important insights on how to assess and treat complex bifurcation lesions, areas of uncertainty still remain. One of them is the side branch (SB) intervention criteria during a provisional SB intervention strategy. Although the provisional SB intervention strategy has become a standard approach for general bifurcation lesions, we still do not have the evidence-based angiographic criteria for SB intervention. Previous randomized trials used the most conservative criteria of slow flow to the most aggressive criteria of angiographic percentage of diameter stenosis after main vessel (MV) stent implantation.

In this issue of JACC: Cardiovascular Intervention, Song et al. (3) present the 3-year follow-up results of conservative versus aggressive strategies for provisional SB intervention in coronary bifurcation lesions. The authors evaluated sophisticated angiographic criteria for left main and non-left main bifurcation lesions (4). For left main bifurcation lesions, the conservative strategy was SB balloon angioplasty for jailed SB >75% stenosis, and SB stenting for SB >50% stenosis or type B or greater dissection after balloon angioplasty. The aggressive strategy was SB balloon angioplasty for jailed SB >50% stenosis, and SB stenting for SB >30% stenosis or type B or greater dissection. For non-left main bifurcation lesions, SB balloon angioplasty and stenting were performed only in an SB with slow flow in the conservative group. SB balloon angioplasty was performed for jailed SB >75% stenosis and SB stenting for SB >50% stenosis after SB balloon angioplasty in the aggressive group. As expected, an SB intervention was more frequently performed in the aggressive group (68.5% vs. 25.8% for SB balloon angioplasty, 30.0% vs. 7.0% for SB stenting). However, the incidence of target vessel failure at 3 years was higher in the aggressive group (20.8% vs. 11.7%, p = 0.049), and this difference originated primarily from the more frequent occurrence of delayed (1 to 3 years) events in the aggressive group. Target lesion revascularization occurred similarly in both the MV and SB at 1 year but predominantly occurred in the MV after 1 year.

This study focused on a provisional SB intervention strategy and was designed to define the optimal angiographic indications for SB intervention. The authors applied different angiographic criteria for left main and non-left main bifurcation lesions to reflect the difference in clinical relevance of the SB and amount of myocardium supplied by the SB between the 2 lesion subsets. As more discrepancy exists between angiographic severity and the functional significance of lesions in smaller vessels than in larger vessels, stricter angiographic criteria need to be applied in non-left main bifurcation lesions. However, it should be emphasized that these sophisticated criteria cannot overcome the inherent limitation of angiographic evaluation for bifurcation lesions. It is well-known that the functional significance of SB lesions cannot be reliably assessed angiographically.

*Editorials published in JACC: Cardiovascular Interventions reflect the views of the authors and do not necessarily represent the views of JACC: Cardiovascular Interventions or the American College of Cardiology.
Furthermore, wide individual variability exists in the visual assessment of jailed SB lesions (6). Therefore, it would have been more informative if the authors used functional as well as angiographic evaluation. Chen et al. (7) performed a randomized study (DKCRUSH-VI [Double Kissing Double CRUSH VI] trial) comparing fractional flow reserve (FFR)-guided and angiography-guided SB intervention strategies in patients with bifurcation lesions. The FFR-guided strategy reduced the need for SB stenting compared with the angiography-guided strategy with a similar composite rate of major adverse cardiac events (cardiac death, myocardial infarction, or clinically driven target vessel revascularization) in both groups (18.1% in both groups) at 1 year. The restenosis rate at the distal MV was higher in the angiography-guided group than in the FFR-guided group (9.9% vs. 1.7%; p = 0.02). As the clinical outcomes of conservative and aggressive groups differ only at 3 years in a study by Song et al. (3), it would be interesting to see whether the long-term follow-up of DKCRUSH-VI trial will show the same trend.

In this study, more clinical events occurred in the aggressive group despite more SB interventions. Furthermore, the incidence of cardiac death or myocardial infarction was numerically higher in the aggressive group during 1 to 3 years, and this difference reached statistical significance at 3 years. There was no interaction between left main bifurcation and treatment effects for target vessel failure. Why did more SB interventions result in more delayed events at the MV? Although most procedures (97.7%) were performed under the guidance of intravascular ultrasound (IVUS) in this study, there were no pre- and post-procedural IVUS findings associated with late clinical events. The amount of neointimal hyperplasia (percentage of neointimal area) in the MV at 9-month follow-up was associated with target lesion revascularization after 1 year. These findings suggest that the subtle damage to the MV stent during an SB intervention can be associated with late clinical events at the MV. As conventional stents do not fit the complex bifurcation geometry, any SB intervention after MV stenting can cause polymer damage, strut deformation, and flow disturbance, which may increase the possibility of delayed events. As follow-up angiography was routinely performed at 9 months in this study, the preponderance of delayed events in the MV represents the difference in the clinical and electrophysiological relevance between the MV and SB.

As an inevitable limitation of long-term follow-up stent studies, one-half of the stents used in this study were first-generation drug-eluting stents, which are not used in current daily practice. As newer generation stents work better than previous ones, especially for complex lesions, the results of this study should be interpreted in the context of this limitation (8,9). Although there was no interaction between treatment strategy and clinical outcomes across stent types, the use of second-generation drug-eluting stents was independently associated with lower rates of target vessel failure at 3 years in this study.

The investigators should be congratulated for their accomplishment of a long-term follow-up study of this randomized trial and reminding us of the important lessons learned from previous trials. Even with the recent advances in devices and technologies, “the less is still the better” for bifurcation PCI. With this in mind, the operators need to ask the following questions before performing PCI for each SB. 1) Does this branch have clinical relevance? 2) Does this stenosis cause myocardial ischemia? 3) Can revascularization improve the outcomes of this patient? Keep in mind that the patient may suffer a great loss when the operator goes for a small gain.

**REFERENCES**


KEY WORDS angiography, bifurcation, revascularization