Invited Editorial / *Davetli Editöryal Yorum*

Percutaneous coronary intervention for bifurcation: Jailed semi-inflated balloon technique

Bifurkasyon perkütan koroner girişimi: "Jail" edilmiş yarı-şişirilmiş balon tekniği

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Abbreviation:

MV	*Main vessel*
PCI	*Percutaneous coronary intervention*
POT	*Proximal optimization technique*
SB	*Side branch*

The main European Bifurcation Club recommendation for percutaneous coronary intervention (PCI) of bifurcation lesions is to use main vessel (MV) stenting with a proximal optimization technique (POT) and provisional side branch (SB) stenting.[1] However, solid evidence regarding the multiple steps of the procedure, including wiring, predilation, main vessel (MV) stenting, side branch (SB) proximal optimization, SB ballooning, SB stenting, and final kissing ballooning, are still lacking. Although provisional stenting is regarded as the optimal strategy, a major drawback of this technique is the risk of SB closure after MV stenting, even when a protection wire is placed into the SB prior to main stenting. SB occlusion after MB stenting occurs in 7.4% to 8.4% of bifurcation lesions, and is associated with serious complications, such as increased risk of peri-procedural cardiac mortality and myocardial infarction.[2,3]

A large quantity of data indicates that the major mechanisms underlying SB compromise are plaque shift, carina shift, and thrombus-related occlusion, particularly in the acute coronary setting.[3] Several recommendations have been made to avoid SB compromise, such as wiring the MV and the SB, avoiding stent overexpansion (distal optimization), the proximal optimization technique, SB ballooning with or without final kissing ballooning, and SB stenting. In order to avoid the risk of SB occlusion after stent implantation, the jailed balloon technique and the jailed semi-inflated balloon technique have been suggested.[4–8]

The jailed balloon technique advocates keeping an uninflated balloon under the stent struts while deploying the stent to the MV. This uninflated balloon potentially reduces both carina and plaque shifts, due to its spatial occupation of the SB ostium. In case of SB occlusion after MV stenting, the jailed balloon may be used either as a marker and a favorable angle modifier to facilitate rewiring, or may be dilated to try to restore SB flow. However, this technique also fails to completely prevent SB occlusion.[8] Therefore, a modification of the jailed balloon technique for treatment of bifurcation lesions, the jailed semi-inflated balloon technique, has been proposed as a superior alternative. This technique involves low-pressure (3 atm) inflation of the jailed balloon in the SB simultaneously during MV stent deployment. During inflation of the MV stent balloon, the proximal part of the jailed SB balloon (behind the MV stent) is compressed and contrast is introduced, overinflating the distal part of the balloon at the SB ostium. The jailed semi-inflated balloon prevents carina or plaque shift due to its full occupation of the SB ostium. When con-

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ventional methods are performed, in the event of SB occlusion, reinsertion of a guidewire into the jailed SB via stent struts to perform the final kissing balloon inflation is mandatory. Since reinsertion of the guidewire after stenting is sometimes challenging and is also associated with the risk of SB injury, the jailed semi-inflated balloon technique without final kissing balloon inflation has been proposed as simpler and better than conventional provisional stenting techniques, especially in true bifurcation lesions. In this technique, after the removal of the SB balloon and wire, the MV stent balloon is removed. Lastly, for optimization, the proximal optimization technique (POT) is implemented with a short, non-compliant balloon for the MV stent. In summary, the theoretical advantage of this method over other techniques is that reinsertion of the guidewire into the jailed SB via stent struts and final kissing balloon inflation are not essential after MV stenting. Only the proximal optimization technique is performed after MV stenting and the protection guidewire from the SB is removed.

In the current issue of this journal, Ermiş et al.[9] describe their clinical experience with the jailed semi-inflated jailed balloon technique in a population of 64 coronary artery patients with a total of 82 bifurcation lesions. Their study is distinguished by the large number (60.9% of study population) of acute coronary syndrome patients. However, the biggest unique feature of this study is the inflation of the jailed balloon at higher pressure. In contrast to other reports of the jailed semi-inflated balloon technique, the SB balloon was inflated with a relatively higher pressure (4.8±2.0 atm). The authors propose that the slightly higher pressure used for the jailed balloon inflation provides better patency of the SB ostium. Among the 62 patients, 5 patients had SB occlusion and were treated with inverted mini-crush, T-stenting, and other minimal protrusion techniques. No entrapment of the jailed balloon or wire was documented. The immediate clinical outcomes and procedural success derived from this study seem to encourage the adoption of the semi-inflated jailed balloon technique. However, this is a single-center study reflecting the experience of a small group of dedicated operators and lacks comparison of this novel technique with other well established bifurcation techniques, as well as low-pressure jailed SB balloon inflation techniques. Moreover, fractional flow reserve and intracoronary imaging (optical coherence tomography or intravascular ultrasound), which facilitate the choice of strategy, reduce unnecessary lesion treatment, and ensure adequate final stent optimization, were not used in this study.

The jailed semi-inflated jailed balloon technique also has some major limitations. First, the proximal marker of the SB balloon should be located more proximal to the stent edge to prevent entrapment. When the jailed balloon is too distally positioned, there is a high risk of entrapment of the inflated jailed balloon after main branch stent deployment. Therefore, a long balloon with double markers is usually required.[9,10] Second, if the SB originates from the main branch at an acute angle, the responses of the plaque and carina after stent implantation may be different.[10] Third, I believe this technique is applicable only if best-in-class balloons, stents, and wires are used. Otherwise, there is a high risk of entrapment with low-quality balloons and wires. Fourth, all of the data regarding the use of jailed balloon techniques are derived from single-center studies and the outcomes probably reflect the practice of highly skilled bifurcation operators. Such complex techniques may yield different outcomes in the hands of less experienced operators, especially when working with equipment of lesser quality. Fifth, tortuosity or heavily calcified lesions of the SB should be considered limitations for a semi-inflated jailed balloon technique, since this method has not been studied in cases of such lesions. Finally, although the procedural success rates seem reasonable, the long-term efficacy and safety of this novel technique is not known and needs further evaluation. Sufficiently powered data comparing this technique with other complex techniques, such as culotte, crush, and T-stenting are also lacking thus far.

There is no consensus on an optimal treatment strategy for bifurcation lesions, probably because coronary bifurcation lesions are characterized by both complexity and diversity, and large, randomized trials with long-term follow-up are lacking. Consequently, several techniques have been advocated by individual operators based on personal preference. Some authors argue that all operators should be familiar with all of the different bifurcation techniques, since each technique has its merits and weaknesses. In our daily practice, we follow the KISSS principle (keep it simple, swift, and safe) in all aspects of interventional cardiology. An appropriate technique should be selected according to the patient's clinical condition, bifurcation anatomy, and finally (last but not least), the operator's experience. In most circumstances, the best bifurcation technique is the one with which the operator is most familiar and experienced, since the long-term result might be more operator-dependent than technique-dependent.

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