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Modified jailed balloon technique for coronary artery bifurcation lesions

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KEYWORDS

- coronary bifurcation lesion
- jailed balloon technique
- stent

Abstract

Coronary bifurcation lesions are one of the most challenging lesions in interventional cardiology in terms of procedural success rate as well as long-term cardiac events. PCI of bifurcation lesions continues to use main vessel (MV) stenting with the proximal optimisation technique (POT) and provisional side branch (SB) stenting as the preferred approach. A jailed SB balloon can restore the SB flow after SB occlusion. In this case report, we introduce a modified jailed balloon technique for coronary bifurcation lesions and illustrate its use using a case description. This involves placing the main vessel (MV) stent in position and a jailed balloon in the SB, inflating the SB balloon with normal pressure, subsequently inflating the MV stent at high pressure, removing the balloons and performing POT using a non-compliant balloon. The modified jailed balloon technique can shift the carina to the MV, keep the SB open, and is safe and feasible for true coronary bifurcation lesions.

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Introduction

Coronary bifurcation lesions are technically challenging, and implantation of a drug-eluting stent is associated with unfavourable long-term angiographic and clinical results. Risk stratification based on coronary anatomy from the recent DEFINITION study showed the benefit of a simpler stenting approach for simple bifurcation lesions[1]. Provisional stenting using a jailed side branch (SB) wire is the most extensively accepted simple technique and is effective for the vast majority of bifurcation lesions[2]. As a jailed wire is unable to prevent SB closure after stenting the main vessel (MV) for all lesions, the recently proposed jailed balloon technique has created a great deal of interest[3]. Similar to the jailed wire approach, the jailed balloon technique requires a small balloon to be positioned in the SB before stenting the MV. Unfortunately, the jailed balloon technique is limited in that: 1) predilating the SB is still required, which is associated with a high incidence of SB dissection; 2) it is unable to prevent SB closure in some difficult cases; and 3) it is very difficult to remove the jailed balloon in very calcified and complex settings. A schematic description of the modified jailed balloon technique is introduced in **Figure 1**, followed by a case description **(Figure 2)**.

Discussion

Percutaneous treatment of coronary bifurcation disease remains technically challenging. The optimal treatment strategy for coronary bifurcation lesions remains to be defined. Provisional stenting using a jailed wire in the SB has been widely accepted as the gold standard in the majority of simple bifurcation lesions[1,2], but is associated with the risk of SB closure after MV stent implantation. SB closure puts patients at high risk, as a significant increase of myocardial biomarkers suggests the presence of myocardial necrosis. Furthermore, the rescue procedure to restore the flow in the SB is more complex and is sometimes impossible. Currently, our understanding of SB closure after stenting the MV is the shift induced by either carina or plaque, and stent struts are usually seen in the ostium of the SB. As a result, a jailed balloon technique has been proposed by several interventionalists[3-5]. However, a jailed balloon technique is not perfect in terms of completely avoiding SB closure. In some cases it is very difficult to remove the balloon from the SB. Most importantly, removing the jailed balloon itself can cause the SB dissection. Dr H.F. Wang described a similar technique at the China Interventional Therapeutic Congress, held in Beijing in 2011. They simply opened the stent with low pressure and after removing the SB balloon, the stent balloon was used to post-dilate the stent. This perhaps pushed the carina back to the SB to obtain perfect matching between the stent and the MV, as simply delivering the stent with a single balloon inflation is almost impossible. Taken together, we introduce our modified jailed balloon technique in this schematic description.

First of all, the MV stent diameter is usually defined according to the diameter of the distal MV but in our case the stent size was chosen according to the proximal LAD trunk. As a result, the stent was well-apposed to the LAD identified by IVUS.

Next, the jailed SB balloon was inflated so as to push the carina from the SB to the MV. Then the MV stent was opened with high pressure to maintain the carina position, minimising the risk of carina or plaque shift and thereby avoiding SB compromise.

Thirdly, POT was used to achieve full apposition of the MV stent just in the proximal MV, which led to minimal pinching of the SB. At this point, a jailed SB wire was still kept in the SB, a way to prevent the further risk of acute closure by the POT approach.

Finally, the performance of final kissing balloon inflation was dependent on the residual stenosis of the ostial SB. In other words, less compromising of the SB does not require additional kissing inflation, as shown in our case. Of course, another option would be FFR-guided kissing inflation for the SB.

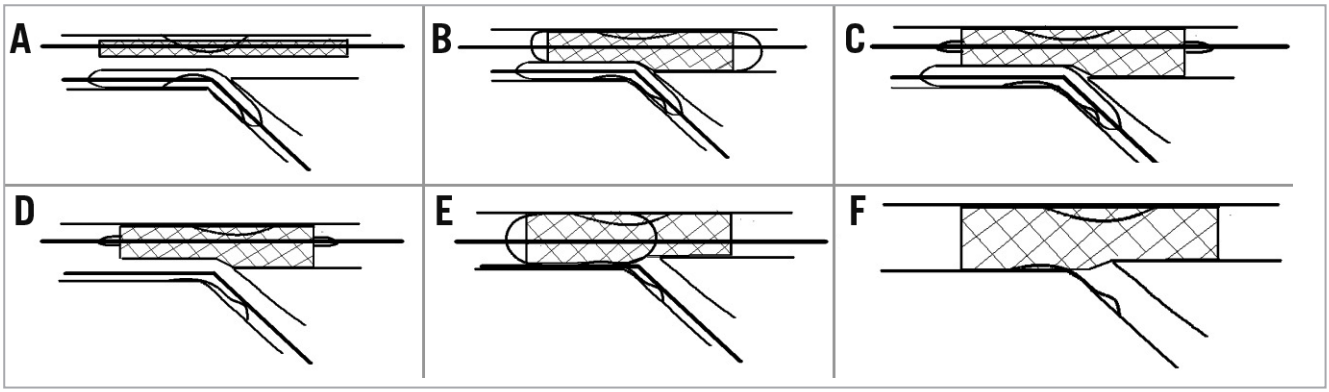

Figure 1. *Schematic description of modified jailed balloon technique. Two wires are positioned in the SB and MV, respectively. The SB balloon/vessel ratio is 1:1, the SB balloon protrudes into the MV by 0.5-1 mm, the SB balloon is inflated with normal pressure (A), and subsequently the MV stent is inflated (at a ratio of 1:1) at high pressure (B). Then, the SB balloon is kept in the SB when the MV stent is deflated (C). Next, the SB balloon is removed and the SB wire is left in position (D). Post-dilation using a non-compliant balloon (E) is performed for the proximal MV stent. Finally, kissing balloon inflation may be used when an angiographically significant ostial SB lesion remains after MV stenting (F).*

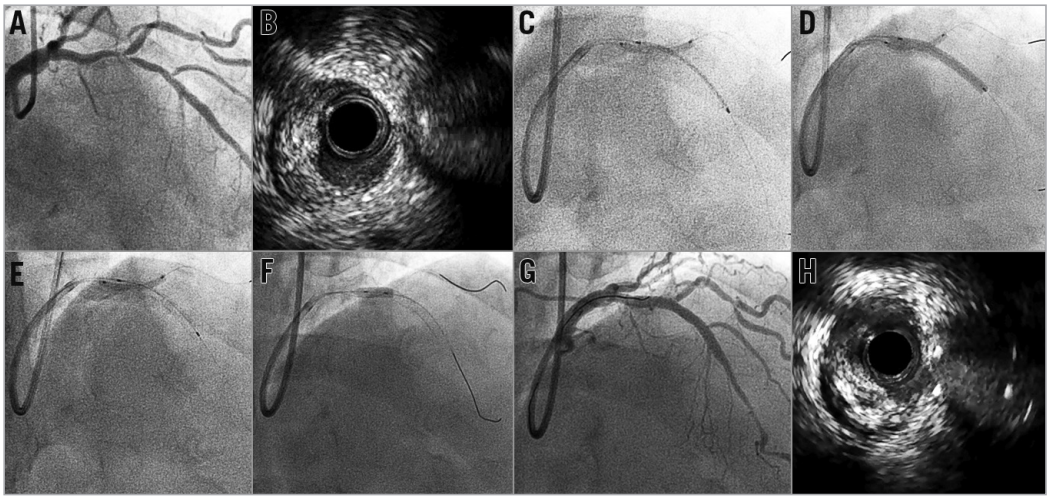

Figure 2. *Case report. The patient was a 56-year-old gentleman, who had had diabetes for four years and who had been complaining of stable angina for three months. Baseline coronary angiography (A) showed true coronary bifurcation lesions involving the left anterior descending artery (LAD) and first diagonal. Intravascular ultrasound (IVUS) confirmed the bifurcation lesions, with minimal lumen area 1.9 mm² in the LAD and 2.6 mm² in the diagonal (B), respectively. A balloon and a stent were simultaneously positioned in the SB and MV, and the SB balloon inflated with normal pressure (C). The SB balloon was kept inflated and the MV stent inflated with high pressure (D). The stent balloon was deflated first and then the SB balloon was deflated (E). After removing the SB balloon, the proximal optimisation technique (POT) was performed using a non-compliant balloon (F). The ostial SB was minimally compromised (G). IVUS found no dissection (H), and the minimal lumen area was 8.8 mm² in the LAD and 3.4 mm² in the SB. Final kissing inflation was not used for this patient.*

Conclusion

In general, our modified jailed balloon technique is safe and feasible for true coronary bifurcation lesions. Further study is required to confirm our preliminary experiences.

Impact on daily practice

Provisional stenting using a jailed wire in the SB has been widely accepted, but associated with the risk of SB closure after MV stent implantation. The rescue procedure to restore the flow in the SB is more complex and sometimes impossible. The modified jailed balloon technique is a safe and easy way to prevent SB closure after MV stent implantation for true coronary bifurcation lesions.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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