

Percutaneous Coronary Intervention for Bifurcation Lesions

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KEYWORDS

• Percutaneous coronary intervention • Bifurcation • Coronary artery disease

KEY POINTS

- Bifurcation lesions are common (approximately 20% of all lesions treated with percutaneous coronary intervention [PCI]).
- Bifurcation PCI is associated with higher risk of complications.
- Careful assessment of the bifurcation lesion by invasive and noninvasive testing is important.
- The provisional 1-stent technique, that is, stenting of the main vessel (MV) with balloon dilatation of the side branch (SB), is preferred when possible.
- Two-stent techniques are necessary in up to 25% of cases and should be mastered.



Video content accompanies this article at <http://www.interventional.theclinics.com/>

INTRODUCTION

More than 3 million PCIs are performed each year. Up to 20% of these procedures include a bifurcation lesion. Bifurcation lesions remain one of the most difficult lesion types to treat, and bifurcation PCI is associated with lower procedural success rates and a higher risk of adverse cardiac events.¹ The optimal management of bifurcation lesions remains a matter of considerable debate. This article summarizes current knowledge of bifurcation lesions and techniques used to treat these lesions.

DEFINITION AND CLASSIFICATIONS

Definition of Coronary Bifurcation Lesions

A coronary bifurcation lesion is defined as a narrowing (usually $\geq 50\%$ angiographic diameter

stenosis) at, or adjacent (3–5 mm) to, the origin of a significant SB.² A significant SB can be defined by different criteria, including reference vessel diameter (ie, ≥ 2.5 mm by visual assessment) or subjectively as a branch that an operator does not want to compromise or lose, taking into consideration factors, such as myocardial area at risk, ischemia location, myocardial viability, patients symptoms, and so forth.

Classification of Coronary Bifurcation Lesions

Coronary bifurcation lesions are anatomically heterogenous and complex. An ideal classification system should be easy to remember, should reflect prognosis and technical difficulty of treating the lesion, and should differentiate between optimal treatment options. Several classifications have been developed for bifurcation lesions.

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These include the Sanborn, Lefèvre, Safian, Duke, Medina, and Movahed classifications.^{3–5} None of these classifications fully captures the nature of bifurcation lesions and none has gained full acceptance. The Medina classification is simple and has been the most widely adopted.⁶ It assigns a binary score (1 if presence of lesion with $\geq 50\%$ diameter stenosis [percent diameter stenosis (% DS)] and 0 if not) to each component of the bifurcation lesion in the following order: proximal segment, main distal segment, and SB.⁷ The values are separated by commas (Fig. 1). A true bifurcation lesion is defined as any lesion involving both the MV, proximal or distal, and the ostium of the SB.⁸ This corresponds to Medina classifications 1,1,1; 1,0,1; and 0,1,1.

The Medina classification is criticized for being too simple. Important parameters that are not captured by the Medina classification include vessel diameter, angulation, Thrombolysis In Myocardial Infarction (TIMI) flow grade, degree of calcification, and plaque distribution. In addition, adjunctive imaging and physiology diagnostic modalities, such as intravascular ultrasound (IVUS), optical coherence tomography (OCT), and fractional flow reserve (FFR), can add additional information.

The relationship between the diameters of the proximal MV, the distal MV, and the SB vessel is important when choosing stent size and/or type. The Huo and Kassab model has been shown to hold true for all bifurcation types (Table 1). This model is particularly useful when, for any reason,

the reference diameter of 1 of the 3 vessel branches cannot be estimated directly.^{9,10}

Anatomic characteristics of bifurcation lesions are incorporated into the Synergy Between PCI with Taxus and Cardiac Surgery (SYNTAX) score. The SYNTAX score was developed to characterize and objectively quantify the severity of coronary artery disease.^{11–13} Bifurcation lesion is considered when all segments involved are of at least 1.5-mm vessel diameter and may involve the proximal MV, the distal MV, and the SB according to the Medina classification. Clinicians should score only the SYNTAX coronary segment numbers of the bifurcation that have a greater than or equal to 50% DS in direct contact with the bifurcation. The smaller of the 2 daughter branches should be designated as the SB. In cases of the main stem, either the left circumflex artery (LCX) or the left anterior descending coronary artery (LAD) can be designated as the SB depending on its respective calibers. A bifurcation where the SB has no lesion greater than or equal to 50% (ie, 1,0,0; 1,1,0; and 0,1,0) adds 1 point to the SYNTAX score; bifurcation with involvement of the SB (0,0,1; 0,1,1; 1,0,1; and 1,1,1) adds 2 points. Also included in the SYNTAX score for bifurcation is the presence of bifurcation angle less than 70° , which, if present, adds 1 additional point.

Classification of Stenting Techniques

Many stenting strategies and techniques exist for treating bifurcation lesions, and more are being

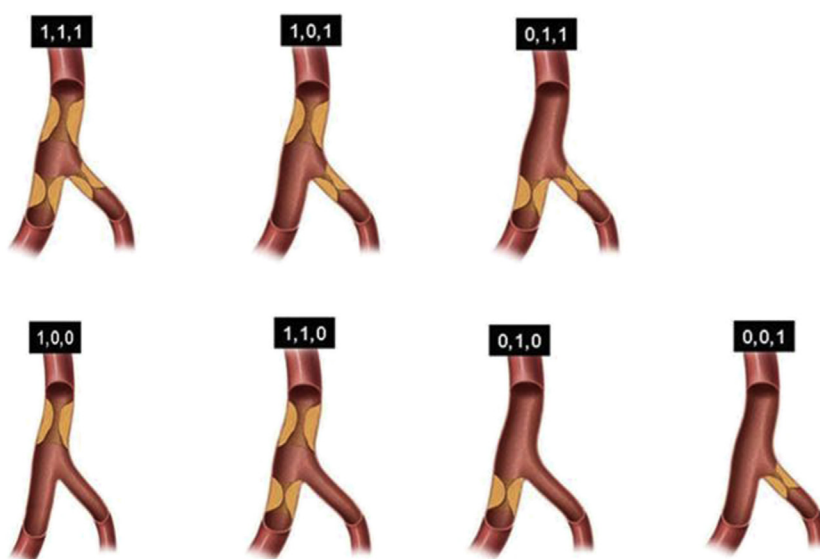


Fig. 1. Medina classification. Each segment is given a binary score depending on the presence (1) or absence (0) of a greater than 50% luminal stenosis. The mother segment is presented first, followed by the distal MV and then the SB.

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