

Letters

TO THE EDITOR

Instantaneous Wave-Free Ratio and Resting Pd/Pa in Tandem Lesions



Kikuta et al. (1) should be commended for demonstrating a good correlation between instantaneous wave-free ratio (iFR) pullback prediction and actual observation of post-percutaneous coronary intervention iFR. However, with careful examination of Figure 3 in their paper, the discordance of those 2 values is not negligible if $iFR = 0.89$ is used as a cutoff; the authors failed to explain the discordance.

Unlike with fractional flow reserve, we demonstrate that residual iFR or Pd/Pa for tandem lesions can be predicted theoretically after 1 of the lesions is stented, based on Ohm's law with only 1 well-accepted assumption: coronary venous pressure = 0 (Figure 1). If lesion 1 (proximal) is stented, the residual iFR is derived as: $iFR_{1s} = \frac{iFR_2}{iFR_1}$; and if lesion 2 (distal) is stented, the residual iFR is derived as: $iFR_{2s} = \frac{iFR_2}{1+iFR_2-iFR_1}$. For the following 3

scenarios: 1) $iFR_1 = 0.9$, $iFR_2 = 0.8$; 2) $iFR_1 = 0.91$, $iFR_2 = 0.66$; and 3) $iFR_1 = 0.75$, $iFR_2 = 0.66$, the iFR pullback method will result in stenting only 1 of the lesions in each scenario. However, on the basis of our prediction formulas, both lesions should be stented to achieve a residual $iFR > 0.89$.

The discrepancy exists because the iFR pullback method does not take into consideration the increased coronary flow from the reduced epicardial resistance after 1 lesion is stented. Other factors may also affect the coronary flow, thus iFR, after 1 lesion is stented, such as flow diversion by the branch arteries between lesions, altered myocardial resistance from increased coronary flow, and increased aortic pressure from relieved ischemia. Both methods are subject to the influence from the latter factors. Our method assumes 0 or low coronary venous pressure relative to the aortic pressure. Caution should be used when the coronary venous pressure is relatively high, such as elevated right atrial pressure, biventricular failure, and so on. Because of the aforementioned potential pitfalls, no matter which method is used for prediction, we recommend remeasuring the iFR or resting Pd/Pa to guide decision making after 1 lesion is stented.

On the other hand, we provide an alternative method for a tandem lesion stenting strategy that can be easily and quickly applied to iFR as well as resting Pd/Pa without coregistration with a coronary angiography.

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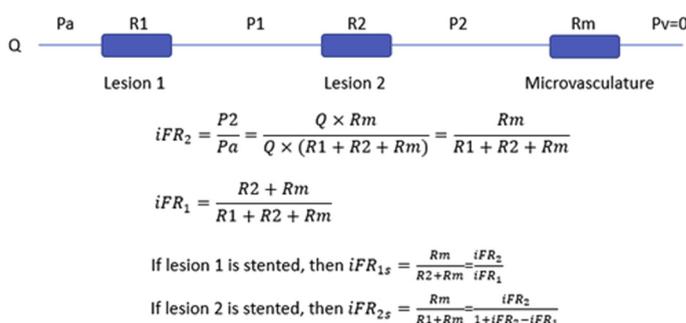
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Please note: Dr. Huang has reported that he has no relationships relevant to the contents of this paper to disclose.

REFERENCE

1. Kikuta Y, Cook CM, Sharp ASP, et al. Pre-angioplasty instantaneous wave-free ratio pullback predicts hemodynamic outcome in humans with coronary artery disease: primary results of the international multicenter iFR GRADIENT registry. *J Am Coll Cardiol Intv* 2018;11:757-67.

FIGURE 1 Derivation of iFR Prediction in Tandem Lesions



iFR = instantaneous wave-free ratio; iFR_{1s} = residual instantaneous wave-free ratio after lesion 1 is stented; iFR_{2s} = residual instantaneous wave-free ratio after lesion 2 is stented; Q = coronary flow; R1 = resistance of lesion 1; R2 = resistance of lesion 2; Rm = resistance of microvasculature.