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Editorial Comment

Distinguishing Physiology From Anatomy: A Comparison of Fractional Flow Reserve and Intravascular Ultrasound Imaging

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There has been significant interest over the past 10 years in the use of techniques, in addition to coronary angiography, that would enable us to understand more about coronary artery pathology during cardiac catheterization. These techniques that go beyond angiography use either a different imaging method or an assessment of the functional significance of the lesion. These techniques include angioscopy, Doppler measurement of flow velocity, intravascular ultrasound imaging, and, more recently, fractional flow reserve. The question we all want to know is what technique is most accurate, which one should we use and under what conditions to optimize our practice of interventional cardiology? I do not believe there is a simple answer to this question, because each method has utility as well as drawbacks; each device has its proponents and opponents. Angioscopy is a superb tool for identifying the presence of thrombus within an artery. It can also distinguish fibrous and fatty plaques based on their color. However, angioscopy is limited by its inability to provide quantitative information or to look beyond the surface of the lumen. Doppler measurement of flow velocity using a 0.0140 guidewire provides a simple method of describing the coronary flow reserve, or the ability of an artery to increase flow under induced hyperemic conditions. This technique has many proponents and has been shown to be capable of guiding the results of balloon angioplasty. The DESTINI trial demonstrated that if the CFR was ≥ 2.0 , the angiographic stenosis was $\leq 35\%$, and there were no significant dissections, then the dilated segment could be left without placing a stent and the 6-month major adverse clinical event rate was similar to the results with stenting. The detractors of the CFR method point out that arterial velocity is dependent on the distal arteriolar resistance and does not always reflect the status of the lesion in the proximal epicardial vessels. Fractional flow reserve (FFR) has advantages of being simple to perform, reproducible, and provides information about the functional significance of the epicardial lesions of CAD. An FFR ≥ 0.75 has been shown to be effective in distinguishing a stenosis that produces ischemia as defined by noninvasive tests such as exercise stress, thallium imaging, or echocardiographic wall motion. But biologic variables are inherently messy and a single cutoff value is unlikely to be accurate in all cases. The accompanying article by Katritsis et al. compares the measurements of FFR with the anatomic cross-sectional information provided by intravascular ultrasound imaging. Although the number of cases described is small, there have been two other comparisons of FFR and IVUS that found similar results. The concordance between these two techniques is about 90%. Therefore, most of the time we would obtain a similar conclusion with either a physiologic parameter (FFR) or an anatomic cross-sectional image (IVUS). An FFR of ≥ 0.75 corresponds to a lumen diameter of 1.8 mm or a lumen cross-sectional area of 4.0 mm². There are two main uses for these techniques; the first is to assess the severity of a lesion prior to an intervention, and the second is to assess the results of a catheterbased treatment. The reported studies

suggest that it is safe to leave a stenosis alone if the FFR is ≥ 0.75 . As long as the patient did not present with unstable angina, the clinical event rate is low in the 6- to 12-month follow-up period. Perhaps this is just another way of deflating our interventional egos by demonstrating that medical therapy can be very effective. When we look with IVUS at these intermediate lesions, one is overwhelmed with the bulk of plaque in these arteries and the severity of the narrowing. This comparison has led some physicians to state sarcastically, "If you want to treat the patient medically, perform an FFR; but if you want to perform an intervention, look at the lesion with IVUS." As distinguished from the preintervention diagnosis where a functional assessment may dissuade us from proceeding, during an intervention we want anatomic information to tell us the following: first, what is the plaque composition and how much plaque is there, so that we can choose our interventional tools to be most effective; second, that we have an optimal lumen cross-sectional area compared to the true vessel size (media-to-media, which cannot be determined by angiography); and third, that there are no significant flaps or dissections despite an acceptable FFR. FFR is useful as a diagnostic tool in the catheterization laboratory because it permits us to perform a physiologic test to determine if a specific lesion is causing ischemia; but I personally use IVUS during complex angioplasty procedures to help choose which device is most appropriate and to determine if the results are optimized.