Editorial

Interventional Cardiology

Values of wire-based coronary physiology assessment in coronary interventional procedures

Editorial

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Ischemic heart disease is a globally leading factor of morbidity and mortality, and angina is the most prevalent symptom. A comprehensive history and examination are essential to recognize patients suffering from acute coronary syndrome. Coronary Artery Disease (CAD) is characterized by atherosclerosis developing in the epicardial vessels, which may be obstructive or non-obstructive. Several basic tests can be completed in patients with suspected CAD, such as bio-chemical testing, a resting electrocardiogram, resting echocardiography, and, in selected cases, ambulatory Electrocardiogram (ECG) monitoring [1].

Physiologic assessment of coronary artery disease plays an important role in guiding the decision to proceed with Percutaneous Coronary Intervention (PCI), bypass surgery, or revascularization delay [2]. The validity of coronary physiology assessment and superior clinical outcomes with physiology-guided PCI compared with angiography guided PCI have been practically established by randomized trials [3,4].

Percutaneous or surgical coronary revascularization aims to recover coronary flow and alleviate myocardial ischemia. The decision-making process in patients with Coronary Artery Disease (CAD) remains largely based on Invasive Coronary Angiography (ICA), however, ICA could not assess the functional significance of coronary artery stenoses [5].

The use of invasive physiological lesion assessment to guide coronary revascularization has been well established in various studies [6-8], has been implemented in guidelines [9], and is increasing in use in clinical practice [10].

Intracoronary physiological assessment is recognized as a valued approach to detect the presence of flow-limiting epicardial stenoses in patients with Chronic Coronary Syndromes (CCS) and to determine an indication for Percutaneous Coronary Interventions (PCI) [11].

The most frequently used index to determine the hemodynamic significance of coronary stenosis is Fractional Flow Reserve (FFR), invasive coronary physiology measurements with coronary guidewires with a pressure sensor, which is defined as the maximum achievable blood flow to a myocardial territory in the presence of a stenosis as a ratio to the normal maximum achievable blood flow to that same myocardial territory in the hypothetical situation the supplying vessel would be completely normal [12]. FFR is the ratio of the pressure measured by the pressure wire distal to a lesion to that measured proximally from the guiding catheter, over the entire cardiac cycle, during hyperemia. Hyperemia is induced by either an intravenous infusion of adenosine at 140µg/kg/min via a central vein (but in routine practice by a large, proximal, peripheral vein) or by

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an intracoronary bolus of adenosine through the guiding catheter (40μg right and 80 μg left coronary artery) [13].

Recently, it was proved that in patients with acute myocardial infarction and multi-vessel coronary disease, a strategy of selective PCI using FFR-guided decision-making was superior to a strategy of routine PCI based on angiographic diameter stenosis for treatment of non-infarct-related artery lesions regarding the risk of death, MI, or repeat revascularization [14,15].

On the other hand, a suboptimal physiologic result is observed after PCI, even in the context of physiology-driven revascularization [16]. This suboptimal result may be avoided in some cases by optimal selection of the lesion that can expect to get sufficient post-PCI physiologic gain. Suboptimal interventional procedure itself can be the reason for a suboptimal physiologic result. In this regard, additional procedures guided by post-PCI physiologic assessment can further improve the results [17]. The FFRSEARCH (Fractional Flow Reserve-Stent Evaluated at Rotterdam Cardiology Hospital) study described potential mechanisms for a suboptimal post-PCI FFR using Intravascular Ultrasound (IVUS) [18]. In addition, in the TARGET-FFR trial, the percentage of patients with the suboptimal post-PCI result (FFR<0.80) decreased significantly by applying the additional PCI procedure compared to the conservative group. However, the additional PCI procedure failed to increase the percentage of the patients who achieved the target post-PCI FFR (>0.90) compared to the conservative group.

Recently, the instantaneous wave-Free Ratio (iFR) is defined as the ratio of resting distal coronary pressure to proximal coronary pressure during a specific part of cardiac diastole, termed the Wave-Free Period (WFP) of when blood flow is at its highest [19]. iFR is a Non-Hyperemic Pressure Ratio (NHPR) that does not require vasodilator administration for maximal hyperemia, so it is quicker to measure in comparison with FFR and prevents patient exposure to side effects of potent vasodilators, which compromises the patient and may simplify physiological assessments in routine clinical practice [20].

Moreover, iFR has been shown to correlate well with noninvasive ischemia testing [21], and to be non-inferior to FFR in guiding revascularization decisions in patients with intermediate Coronary Artery Disease (CAD) in 2 large randomized clinical trials that are iFRSWEDEHEART (Instantaneous Wave-Free Ratio Versus Fractional Flow Reserve in Patients with Stable Angina Pectoris or Acute Coronary Syndrome) trial [22], and DEFINE-FLAIR (Functional Lesion Assessment of Intermediate Stenosis to Guide Revascularization) trial [23].

A reliable and proven technique called Computed Tomography-Based FFR (FFR CT) can effectively model FFR in the major coronary vessels using computed tomography [24]. This technique can evaluate atheroma magnitude, pattern, and presence, along with vessel-specific ischemia by creating an anatomical model of the arteries and a physiological model of the circulation process. Resting coronary flow is calculated based on myocardial mass, the maximum hyperemia is estimated by considering the expected reduction in resistance with adenosine injection and the FFR CT is then measured using supercomputers and computational fluid dynamics methods.

FFR CT provides additional anatomical information within physiological assessment, lowering the number of invasive coronary angiography exams and the need for invasive FFR measurement, a cost-efficient method, and non-inferiority compared with invasive FFR. Several studies confirm the reliability of this noninvasive assessment for stable angina patients, like PACIFIC [25], ADVANCE [26], and TARGET [27] trials.

FFR CT can help in assessing and treating patients with positive clinical outcomes while decreasing the need for invasive angiography. So, it is reasonable to assume that routinely investigating the anatomy and physiology of all epicardial coronary arteries would lead to better diagnostic outcomes [1].

In conclusion, invasive physiological assessment including the physiological indices has become an important component of patient assessment in the cardiac catheterization laboratory. These strategies enhance our information on IHD, and how it is best treated. However, FFRCT is a noninvasive technique with low risk of adverse events and holds clinical potential to provide anatomic and hemodynamic significance of coronary lesions.

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