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Editorial
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Importance of Non-Invasive Techniques for the Diagnosis of Coronary Atherosclerotic Artery Disease

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Editorial

Cardiovascular Disease (CVD) remains the leading cause of death among Europeans and around the world. The Global Burden of Disease study estimated that 29. 6% of all deaths worldwide (15616.1 million deaths) were caused by CVD in 2010, more than all communicable, maternal, neonatal and nutritional disorders combined, and double the number of deaths caused by cancers [1,2].

CVD is the leading cause of death in Europe, and despite recent decreases in mortality rates in many countries, it is still responsible for over 4 million deaths per year, close to half of all deaths in Europe. The proportion of all deaths that are attributable to CVD is substantially greater among women (51%) than men (42%) [1,2].

Coronary heart disease (CHD), when considered separately, accounts for almost 1.8 million deaths, or 20% of all deaths in Europe annually. The gender differences in the proportional contribution of CVD to total mortality is driven far more by stroke and other CVD, and among both men and women, CHD causes one in five of all deaths [2].

CHD alone caused ≈ 1 of every 7 deaths in the United States in 2011. In 2011, 375,295 Americans died of CHD [3]. Each year, an estimated ≈ 635,000 Americans have a new coronary attack (defined as first hospitalized myocardial infarction or CHD death) and ≈ 300,000 have a recurrent attack. It is estimated that an additional 155,000 silent first myocardial infarctions occur each year. Approximately every 34 seconds, one American has a coronary event, and approximately every 1 minute 24 seconds, an American will die of one [3].

An estimated 15.5 million American adults have chronic coronary artery disease, and more than 7 million have angina. Angina is the initial manifestation in approximately half of all patients who present with coronary artery disease. The presence of chronic angina approximately doubles the risk of major cardiovascular events [4-6].

Therefore, early diagnosis of the coronary atherosclerotic artery disease with non-invasive techniques is very important. At present we have multiple non-invasive modalities of images for diagnosis of coronary atherosclerotic artery disease: stress echocardiography (sensitivity: 80%; specificity: 90%), gated SPECT (sensitivity: 86%; specificity: 80%), gated PET (sensitivity: 89%; specificity: 90%), stress magnetic resonance perfusion (sensitivity: 91%; specificity: 90%); stress magnetic resonance wall motion (sensitivity: 83%; specificity: 86%), and coronary computed tomography angiography(sensitivity: 98%; specificity: 84%). On the other hand, the cycle-ergometry stress testing (sensitivity: 68%; specificity: 77%) are not an obsolete test, in some cases it is the first step for the evaluation of patients who are unable to do a treadmill test or to perform an echocardiogram during maximum effort.

In the last few decades, these techniques have become widely used worldwide for risk stratification and guiding management of patients with suspected or known coronary artery disease. A normal study is well established as being associated with a very low risk of cardiac events. For example, the radionuclide stress myocardial perfusion imaging is considered gatekeeper for coronary angiography, and a normal myocardial perfusion gated SPECT (Single Photon Emission Computed Tomography) generally indicates a good prognosis. When no fixed or reversible perfusion defects are observed on stress-rest SPECT, the likelihood of hard cardiac events (death due to cardiovascular causes, or acute myocardial' infarction) during the first year is less than 1% [7-9].

Nevertheless, depending on various clinical characteristics, such as age, gender, diabetes, known coronary artery disease, type of stress test performed, electrocardiographic and clinical findings

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during stress, risk can climb to as much as 3% annual cardiac events [10-19]. These factors can change the normal SPECT warranty period, understood to be the period during which repetition of the test is considered to be uncalled for because of the low risk of complications [9]. It's important to know, that the warranty periods for a normal stress myocardial perfusion SPECT vary considerably, since they are determined mainly by the type of stress, left ventricular systolic function, and clinical variables [9]. The warranty period of patients with a normal SPECT who have undergone dipyridamol myocardial perfusion imaging is lower than that of patients undergoing exercise plus dipyridamol myocardial perfusion imaging or those undergoing exercise myocardial perfusion imaging. The warranty period is also shorter in the case of abnormal left ventricular ejection fraction on gated-SPECT, even when perfusion imaging is normal [9].

However, an underestimation of the presence of high-risk anatomic coronary artery disease(3 vessels with ≥ 70% stenosis, 2 vessels with including the proximal left anterior descending, or left main with ≥ 50% stenosis) by SPECT myocardial perfusion imaging has also been well described [20-22]. In part, this has been attributed to the reliance of the method on relative perfusion defects in the myocardium compared to more normal zones [20-23]. The possibility of having a normal test result in a patient with high-risk angiographic findings can be clinically problematic with respect to guiding decisions regarding the need for invasive coronary angiography [22]. Variables associated with high-risk coronary artery disease are pretest probability of coronary artery disease ≥ 66%, summed stress score >0, abnormal transient ischemic dilatation, and left ventricular ejection fraction change stress-rest [22-23]. The prevalence of high-risk coronary artery disease increased as the number of these predictors increased [22].

With conventional SPECT, myocardial tracer uptake in each myocardial region is assessed relative to the most normal myocardial region. In the setting of balanced myocardial ischemia due to balanced anatomy (left main plus right coronary stenosis with or without other stenosis or three vessel disease), the myocardial perfusion pattern may appear normal (homogeneous) due to the absence of a normally perfused myocardial reference region [22,24]. The ability to assess absolute myocardial blood flow and myocardial blood flow reserve with PET (Positron Emission Tomography) represents a major advantage of PET for detection of multi-vessel coronary artery disease [24]. On the other hand, advances in nuclear cardiology due to the development of dedicated ultra-fast cardiac cameras able to provide high-quality, high-resolution, and high-diagnostic myocardial images facilitate tomographic dynamic acquisition with the theoretical possibility of investigating radiotracer kinetics in vivo [25]. Quantification of myocardial perfusion reserve using dynamic SPECT may identify balanced ischemia in patients with left main or 3-vessel disease [25].

Coronary artery calcium scoring is other non-invasive technique to estimate the amount of coronary atherosclerosis [26,27]. That coronary artery calcium scores influence clinical decision-making and increases early referral for invasive coronary angiography in stable low-intermediate risk patients with normal SPECT. Particularly, patients with a high coronary artery calcium score >400 or a high percentile score (>75th) had a strong and independent risk of referral for invasive coronary angiography [26,27]. In the future, the importance of non-invasive techniques for the diagnosis of coronary atherosclerotic artery disease should and can be further improved, with a good efficacy and cost-effectiveness.

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