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Conventional Cardiological Nuclear Diagnostics in the Third Millennium

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In recent years the progress of Nuclear Medicine has led to the creation of new equipment and new radiopharmaceuticals, resulting in a deep change in procedures. One of the most important of these is undoubtedly the introduction into the clinical practice of positron emission tomography (PET) and the consequent synthesis of a whole series of positron emitting radiopharmaceuticals.

New techniques have obviously improved also the diagnostic performance of myocardial ischemic disease. In this short review we intend to examine, in the cardiology field, the validity of conventional nuclear medicine technologies, leaving PET to the oncological pathology, in which it has deeply changed the management of cancer patients.

One of the major problems inherent in conventional cardiologic diagnostics with radioisotopes is the radiation dose received during such diagnostic investigations, by patients, by operators and by the population. Different methods can be used to reduce the effective dose resulting from nuclear diagnostic investigations for cardiology. For example the use of 99mTc (technetium) sestamibi or tetrofosmin as preferred radiopharmaceuticals in single photon emission computed tomography (SPECT) and the use in patients with low probability pre-test of disease with stress-first / stress-only protocols can be used to minimize the dose in cardiac nuclear imaging [1,2].

Moreover, to considerably decrease the effective dose and acquisition time for myocardial perfusion SPECT with preserved image quality, the recent introduction of new SPECT detectors with cadmium zinc telluride technology can be used [3]. The improved image resolution should improve diagnostic accuracy and increase the value of SPECT imaging for management of patients with CAD, at a time of significant competition from other imaging modalities [4, 5]. In the diagnostic, prognostic and management process of patients with suspected or established CAD, CZT MPI represents an important step forward. But the most important thing about this technology is the fact that in apparently healthy subjects will open the door to the potential application of MPI in the primary prevention of cardiovascular disease. But the most important thing about this technology is represented by the fact that in apparently healthy subjects it will open the way to the potential application of MPI in the primary prevention of cardiovascular diseases [6]

Even more, the pure anatomical characterization of a coronary stenosis can be integrated, for an appropriate clinical decision making process, from functional information. Cardiac hybrid imaging, obtained by combining coronary computed tomography angiography (CCTA) and single photon emission computed tomography (SPECT) for myocardial perfusion imaging (MPI) [7], is the best method to evaluate coronary anatomy and function at the same time, producing a well-documented added clinical and prognostic value [8-10]. Patients with a normal fusion myocardial perfusion SPECT/coronary CT angiography examination have an excellent prognosis at long-term follow-up [11]. Cardiovascular outcomes are worse in patients with matched abnormalities at

SPECT/CT angiography than in those with unmatched abnormalities [12]. Cardiac hybrid imaging may have a great impact on clinical long-term outcome; Benz et al. concluded that in CAD patients early revascularization is associated with an outcome benefit with a matched finding documented by cardiac hybrid imaging, and no benefit of revascularization was observed in patients with an unmatched finding [13].

However, it has long been known that using a SPECT/CT hybrid machine contributes significantly to the best diagnostic definition, particularly for the inferior-basal segments of the left ventricle as it allows for the correction of attenuation, especially in no tall and overweight patients [14].

As is well known, the study of myocardial perfusion with radioisotopes has for years been the basis for determining diagnosis and prognosis in patients with coronary artery disease. The use of 123I-MIBG for the assessment of myocardial innervation allows to reveal the areas of myocardial perfusion and innervation mismatch in those patients with severe myocardial dysfunction [15]. The possibility of carrying out both evaluations with a single examination after the double tracer administration minimizes the possibility of errors compared to the two measurements taken separately and represents a considerable comfort for the patient [16].

Myocardial perfusion assessment, as it is known, should be practiced after stress which may be physical or pharmacological. Pharmacological stress employs vasodilators that induce hyperaemia mediated by adenosine receptors regardless of oxygen demand [17]. Since only A2A receptors induce coronary vasodilation, they are the same that provoke side effects. Some years ago was introduced in clinical practice a new vasodilator that act only on A2A receptors without other receptor stimulation, so without side effects, called regadenoson. Regadenoson provides diagnostic information comparable to a standard adenosine infusion, with no serious drug-related side effects, and, moreover, regadenoson was better tolerated than adenosine [18]. Even more, since there was not observed relation with a decline in forced expiratory volume (FEV1) [19-21], regadenoson can also be used in patients with mild asthma. The most recommended use of regadenoson appears to be to administer it in the recovery of inadequate stress tests, in order to reveal reversible defects of uptake, resulting well tolerated in patients marks signs and symptoms of ischemia during exercise or recovery [22].

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