Gated SPECT beyond myocardial perfusion: assessment of mechanical left ventricular synchrony

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Gated SPECT myocardial perfusion imaging (GS-MPI) has a high sensitivity for the diagnosis and prognosis of coronary artery disease (CAD). We can evaluate not only myocardial perfusion but left ventricular function parameters (LVF). It has been established as the high prognostic value to predict major coronary events (MCEs) including cardiac death, mainly in post-stress images.^{1,2}

Otherwise, left ventricular systolic function, end-systolic and end-diastolic volumes, as well as the ejection fraction are strong cardiac death independent predictors despite myocardial perfusion. The role of myocardial perfusion and ventricular function has been extensively validated to predict MCEs.¹⁻³

Usually, a normal MPI with normal LVF is associated with a low risk of coronary events, with a guarantee period that depends on the presence and control of coronary risk factors.^{4,5}

Nevertheless, we can find balanced ischemia in subjects with multivessel disease, (false-negative study), despite the existence of an important coronary obstructive disease.

The coronary flow is generally decreased in the three coronary territories and remains relatively homogeneous with a problem to detect ischemia.⁶⁻⁹

Nowadays, GS-MPI allows us to analyze left ventricular systolic function parameters, but it is also to analyze left ventricular mechanical dyssynchrony (LVMD) too (Fig. 1).¹⁰ The greatest utility has been found to select candidates with heart failure for cardiac resynchronization therapy (CRT), to decrease the percentage of non-responders, which is high around 20% to 40% (Fig. 2).¹¹

The evaluation of LVMD is very simple, the study is acquired regularly in a conventional gamma camera, using the same injection and acquisition of the GS-MPI, but it requires special software for dyssynchrony analysis.

Phase standard deviation and phase bandwidth are the 2 most validated mechanical dyssynchrony parameters indicating the time it takes contraction of the ventricle within the cardiac cycle.^{12,13} Reference values of synchrony parameters in healthy subjects have been published and also the values to predict a high probability of response to CRT.^{10,14-16} But it is also necessary to demonstrate that the asynchronous area does not correspond to a necrotic zone, which can be easily done by comparing the synchrony image with the myocardial perfusion image.¹⁷

Another less used utility of the GS-MPI is the relationship of the infarction extent, the amount of ischemia burden, or left ventricle systolic dysfunction with the alterations in ventricular synchrony induced by physical or pharmacological stress and their prognostic value.

In particular, interesting is the hypothesis that in multivessel disease and balanced ischemia patients, a stress test can lead to a global left ventricular mechanical dyssynchrony (LVMD) observed with an increase of the dyssynchrony parameters from the baseline rest results. This utility could be a great advantage in multivessel disease and balanced ischemia patients.^{18,19} However, this alteration could also occur as a

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Figure 1. GS-MPI with LVMD in an area of perfusion defect caused by a myocardial infarction.

Figure 2. GS-MPI with LVMD assessment prior and 1-year follow-up CRT St Jude Allure Quadra implantation in DDDR mode.

consequence of baseline alterations in the left ventricular function that are accentuated by the stress test, even in the absence of ischemia, which would be more likely to occur with physical exertion and not with the use of coronary vasodilators. In any case, stress-induced left ventricular dyssynchrony could theoretically indicate a

significant risk of major coronary events, deterioration in left ventricular function, or cardiac death.

Tomohiko Sakatani et al investigated retrospectively LVMD and evaluated the indices of phase bandwidth and phase standard deviation with ^{99m}Tc Tetrofosmine GS-MPI in subjects with normal

myocardial perfusion imaging results. They separated patients who underwent physical ($N = 310$) vs pharmacological stress ($N = 608$) during the follow-up period of 2.2 years (± 1.9 years). They found that LVMD stress bandwidth induced by physical exercise stress was an independent predictor of MCEs in patients with normal perfusion SPECT (HR 1.017, CI 1.003–1.032, $P = 0.019$), whereas pharmacological stress had no association with further events.²⁰

Beyond the myocardial perfusion, GS-MPI provides important information in the analysis of mechanical left ventricular synchrony, which has proven to be useful in the selection of patients for cardiac resynchronization therapy, identifying perfusion artifacts and potentially balanced ischemia patients. Therefore, routine inclusion of this analysis should be considered and informed.

Disclosure

Erick Alexánder-Rosas and Salvador Hernández-Sandoval have no conflicts of interest to disclose.

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