Assessment of left ventricular volumes; reliable by gated SPECT?

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Assessment of cardiac function continues to be an important issue in patients with assumed left ventricular dysfunction [1–10]. In particular in patients with enlarged left ventricles, such as occurs in ischemic and idiopathic dilated cardiomyopathy, accurate assessment of left ventricular function remains pivotal [11–14]. To assess myocardial function, different diagnostic methods are currently performed, such as MRI, SPECT, and echocardiography [15–23]. In the clinical arena, detection of myocardial function is predominantly based on echocardiographic studies. However, nuclear techniques, showing preserved tracer uptake and metabolism in viable myocardium, may also assess left ventricular function and wall motion. Analysis by gated SPECT imaging offers considerable additional value to SPECT myocardial perfusion imaging in characterizing functional abnormalities thereby potentially improving test specificity [24–30]. Preserved wall motion and/or thickening in region with perfusion defects might denote remaining viability indicating potentially well functioning myocardium [31–36]. By assessing left ventricular volumes the application of gated SPECT influences the appropriate management strategy. Since myocardial perfusion, function and wall motion/thickening can be assessed simultaneously, gated SPECT imaging follows the concept of a one-stop shop such as propagated by MRI studies [37–41]. However, MRI may be more accurate than gated SPECT in establishing left ventricular parameters because of its superb spatial resolution [20, 42–49].

In the current issue of the *International Journal of Cardiovascular Imaging*, Sipola et al. [50] prospectively compared left ventricular end-diastolic volume (EDV), end-systolic volume (ESV), and ejection fraction (LVEF) both by gated SPECT and cardiac MRI in 21 patients with idiopathic dilated cardiomyopathy. All 21 patients underwent both 99 mTc-tetrofosmin gated SPECT imaging and MRI within a 3 h interval. Close linear correlations were observed between both methods in left ventricular EDV and left ventricular ESV but correlations were significantly weaker for LVEF. Left ventricular EDV and left ventricular ESV were smaller for gated SPECT than for MRI. In 4 patients (21%) the left ventricular EDV index was considered normal by gated SPECT and increased by MRI, if MRI-derived normal values were used. No differences were found between gated SPECT and MRI when MRI-determined LVEF was below 40%. However, gated SPECT showed smaller LVEF when MRI-determined LVEF was over 40%. The authors concluded that an increased left ventricular EDV in gated SPECT is reliable compared with
MRI. Nevertheless, left ventricular volumes were systematically underestimated by gated SPECT and underestimation was higher in patients with dilated left ventricles. No direct comparisons could be made between the two methods in follow-up studies. Based on these findings [50], the authors suggest that abnormal gated SPECT results should be confirmed by other imaging modalities, such as MRI, if these findings have therapeutic consequences.

In comparing gated SPECT data with data from established imaging techniques, inconsistent results have been reported. Atsma et al. [51] compared technetium-99m tetrofosmin gated SPECT imaging and contrast ventriculography in the assessment of global and regional left ventricular function in 74 patients with undiagnosed chest pain of whom 27 sustained a previous myocardial infarction. The authors reported that gated SPECT imaging is an accurate and reliable clinical tool to accurately measure global and regional left ventricular function. Bavelaar-Croon et al. [52] compared results from quantitative gated SPECT with results from MRI in the assessment of left ventricular EDV, ESV, and LVEF. Between the two methods, correlations were good for LVEF ($r = 0.85$), EDV ($r = 0.94$), ESV ($r = 0.95$). Wahba et al. [53] showed that gated SPECT imaging when compared to MRI is a reliable tool for the assessment of regional wall motion and thickening in patients with known or suspected coronary artery disease. In particular in patients with a previously sustained myocardial infarction gated SPECT imaging has the potential to detect preserved wall motion and thickening in regions with fixed perfusion defects indicating the potential presence of residual myocardial viability. Bax et al. [54] showed close and significant correlations for assessment of left ventricular volumes, and regional wall motion by MRI and gated SPECT in patients with ischemic cardiomyopathy.

On the other hand, in a meta-analysis including nine studies, Ioannidis and coworkers [55] demonstrated that gated SPECT measurements of left ventricular EDV, ESV and LVEF showed indeed high correlation with cardiac MRI measurements, but substantial errors may occur in individual patients. Persson et al. [56] reported in 55 patients with known or suspected coronary artery disease that gated SPECT, compared with MRI, systematically underestimated EDV, ESV and LVEF. This phenomenon might be due to the inclusion of the outflow tract area by MRI, which is not part of left ventricular volume acquisition with gated SPECT because of low counts in this area. This holds in particular for dilated left ventricles as the basal left ventricle constitutes a higher absolute volume than in patients without left ventricular dilatation. As already noticed by Sipola et al. [50] the study by Wang et al. [57] showed that the correlation between gated SPECT and cardiac MRI was excellent for LV volume and LVEF values in patients with idiopathic dilated cardiomyopathy. However, algorithm-varying over- or underestimation of left ventricular volumes and LVEF should be accounted for in the clinical context.

To summarize, the current study by Sipola et al. [50] clearly demonstrates that gated SPECT offers useful and reliable functional information on left ventricular function, which makes it suitable for follow-up studies and guiding clinical management. However, when accurate measurements of cardiac volumes are required cardiac MRI should be used. This holds in particular for patients with dilated cardiomyopathy.

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