Detection of multivessel coronary artery disease: looking beyond the extent of perfusion abnormalities

Dipan Desai, DO, Gorgi Kozeski, DO, and Olakunle Akinboboye, MD

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The sensitivity of stress myocardial perfusion scintigraphy for detecting coronary artery disease (CAD) in patients with multivessel CAD is high.[1-4] However, its ability to predict the presence of multivessel disease is limited. It has been suggested that the presence of left main or multivessel disease is missed in up to 50% of cases.[5,6] The possible reasons for this include balanced perfusion abnormality, where the absence of a normal reference segment limits sensitivity, early plateau of tracer uptake, which limits detection of borderline stenoses, and early stoppage of exercise as a result of symptoms or signs due to the severest lesion.

There is evidence that ancillary clinical, exercise, and scan variables can improve the sensitivity of a gated SPECT myocardial perfusion study for detection of multivessel CAD.[7] These include poor exercise tolerance and development of chest pain and/or electrocardiographic evidence of ischemia at a low exercise workload,[8] increased lung/heart tracer uptake ratio,[9] and transient ischemic dilation of the left ventricle following stress (TID), which was shown to be a specific but fairly insensitive marker of multivessel CAD. Initial studies with planar Tl-201 imaging found a cut-off TID ratio of 1.12 to have the best sensitivity and specificity for detecting multivessel CAD. A subsequent study with dual-isotope imaging reported an optimal cut-off of 1.22.[10] Other approaches include integration of functional assessment by gated SPECT with conventional perfusion analysis;[3,11] comparison of RV to LV activity, which was shown to be a marker of severe CAD, particularly high-grade left main or proximal LAD or LCx, without concomitant proximal RCA disease;[12] and normalization of the stress to a normal reference segment identified on the resting study.[13]

Others studies have suggested that a better approach for detecting multivessel CAD is to perform PET perfusion imaging.[14] The advantages of PET include the availability of a robust attenuation correction algorithm and the fact that some PET tracers have superior flow tracking ability to the commonly used technetium-based SPECT perfusion tracers. However, the limited availability of PET scanners limits the clinical utility of this approach.

Hida et al[15] evaluated the use of left ventricular function after exercise as a predictor of multivessel CAD in 175 patients who underwent gated SPECT myocardial perfusion imaging and coronary angiography within 3 months. They reported sensitivities and specificities for detecting multivessel CAD of 66% and 87%, 52% and 83%, and 46% and 90% for an increase in post-exercise ESV of 5 mL, decrease in post-exercise ejection fraction of 5%, and a summed difference score of 9, respectively. On multivariate analysis, they found that the combination of post-stress increase in ESV, summed difference score, and diabetes mellitus had the best sensitivity and specificity (72% and 84%, respectively) for detecting multivessel CAD. In this issue of the journal,[16] the same investigators reported on the diagnostic value of post-stress left ventricular volume and function analyses with vasodilator stress testing. They studied 119 patients who underwent gated Tc-sestamibi gated SPECT with adenosine triphosphate and coronary angiography within 3 months. Fifty-one percent of the patients had multivessel CAD including 45 patients with double-vessel and 16 patients with triple-vessel disease. They found sensitivities and specificities for detecting multivessel CAD of 57%, and 64% for summed stress core $\geq$14, and 53% and 88% for summed difference score $\geq$9. These sensitivities, specificities, and accuracy measurement after ATP loading were similar to their observations with exercise stress. In addition, the authors evaluated the utility of change in end-systolic volume, end-diastolic volume, and ejection fraction and stress-induced volume ratio (SIVR) defined

From the New York Hospital Medical Center of Queens, Weill Medical College of Cornell University, Queens, NY.
Reprint requests: Olakunle Akinboboye, MD, New York Hospital Medical Center of Queens, Weill Medical College of Cornell University, Queens, NY; *olak2@yahoo.com.*
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as stress to rest ratios of (ESV × 5 + EDV) for detecting multivessel CAD. They found that a derived cut-off of >6 mL increase in ESV or EDV, or a >5% decrease in EF after stress, and SIVR of ≥1.13 demonstrated sensitivities of 59%, 80%, 61%, and 74%, respectively, and specificities of 72%, 76%, 77%, and 78% respectively. On multivariate analysis, the combination of post-stress increase in ESV and the SDS performed best for identification of multivessel CAD with 80% sensitivity and 76% specificity.

Identifying multivessel disease pattern on a SPECT myocardial perfusion study is very important because of its management implications. Patients with multivessel disease have poorer prognoses and are more likely to benefit from coronary revascularization.

Hida et al[16] offered an approach to detection of multivessel CAD by gated SPECT, which integrates the extent of reversible perfusion abnormality and post-stress LV dilation. The strength of this approach is that it uses data that are readily available on a standard gated SPECT myocardial perfusion study without requirement for additional processing. However, since increased SDS or post-stress LV dimensions are more likely to occur in patients with reversible CAD, it will be interesting to know how well the approach performs in patients with prior infarction.

Reliable detection of multivessel CAD remains a challenge for gated SPECT perfusion imaging. Integration of information about the extent of reversible perfusion abnormality and change in left ventricular systolic volume post-exercise as suggested by Hida et al[16] may mitigate this problem.

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