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**EDITORIAL**

# Assessment of Mechanical Function as an Adjunct to Myocardial Perfusion/Metabolism Emission Tomography Studies

An increasing number of myocardial perfusion and metabolism studies are being performed with either PET or SPECT to assess myocardial perfusion and viability. To date, the conventional imaging approach has been to perform these studies ungated to expedite image acquisition, processing, interpretation and storage. Unfortunately, ungated acquisition limits the clinical value of the perfusion/metabolism study in an important way. Functional information that may be gathered from the qualitative or quantitative analysis of the motion and thickening of the myocardial wall is lost. The article by Miller et al. (*1*) in this issue describes a method of assessment by PET of left ventricular global and regional mechanical function from ECG-gated images following red cell labeling with $^{15}$O-carbon monoxide. Clearly, in these days of health care reforms, fiscally responsible referring physicians would never request that a myocardial perfusion/metabolism emission tomography study be performed on a patient just to assess ventricular function. This assessment is customarily performed adequately and more frugally with other techniques such as radionuclide ventriculography or two-dimensional echocardiography. Nevertheless, the same fiscally-minded referring physicians would want to utilize available functional information when they send their patients for the assessment of myocardial perfusion and/or metabolism using emission tomography studies.

In using $^{15}$O-water studies for assessment of myocardial perfusion, a correction is required for the radioactivity in the vascular compartment (*2*). The group at Washington University has used a separate inhalation of $^{15}$O-carbon monoxide to label red blood cells and delineate the vascular pool in order to make this correction (*2*). Thus, Miller et al. (*1*) are suggesting that if the $^{15}$O-carbon monoxide study has to be performed in order to make this correction, why not capture and quantify the important myocardial mechanical function information that it provides. This assessment of myocardial function is particularly relevant in questions of myocardial viability, since a wall that is moving, and particularly thickening, is viable.

Moreover, as pointed out by Miller et al. (*1*), simultaneous assessment of myocardial function and perfusion/metabolism guarantees accurate registration of anatomic segments between the function and perfusion/metabolism study as well as guaranteeing the assessment of these myocardial characteristics in the same physiologic state. These are two attributes which are very difficult to guarantee when performing the assessment of function and perfusion/metabolism with different modalities at different times. The measurement of global and regional left ventricular function from cardiac

Received Mar. 16, 1994; accepted Mar. 17, 1994.
For correspondence or reprints contact: Ernest V. Garcia, PhD, Center for Positron Emission Tomography, Emory University Hospital, 1364 Clifton Road, NE, Atlanta, GA 30322.

PET can be quite important since it not only provides additional information to measurements of perfusion and metabolism but also because it is a three-dimensional, attenuation-corrected technique and has the potential to be significantly more accurate than planar, radionuclide ventriculography imaging techniques. The approach described by Miller et al. (*1*) was to use the PET images obtained with an inhalation of $^{15}$O-carbon monoxide to generate attenuated, planar images to simulate the conventional scintigraphic imaging results. Although these PET planar measurements correlated well with the conventional planar blood-pool imaging approach, their technique has all the well-known limitations related to attenuation and tracer superimposition of conventional planar approaches. Although difficult, it would be desirable if three-dimensional emission tomography techniques were validated for their assessment of mechanical function against independent, three-dimensional gold standards such as cardiac MRI.

Another important issue related to the need for performing ECG-gated myocardial perfusion/metabolism emission tomography studies not directly addressed by Miller et al. (*1*) is how the qualitative and/or quantitative evaluation of the myocardial tracer distribution is being effected by the smearing of the counts from moving walls and whether this effect could cause misdiagnosis of myocardial viability or blood flow. Accurate assessment of myocardial perfusion/metabolism requires that heart motion be stopped. ECG-synchronized gated emission tomography studies applied to myocardial perfusion/metabolism studies can be used for such a purpose. Even though end-diastolic or end-systolic electrocardiographic gated tomograms contain a fraction of the number of counts of ungated tomograms, they are both more quantitative and of higher quality than ungated images since the smearing effect of wall motion has been eliminated yielding images of higher spatial resolution. It is a fact that without gating there is a smearing of the counts coming from tracer distribution in moving walls creating problems in interpreting myocardial perfusion distribution. For instance, if the same patient has two normally perfused walls, one that moves significantly and one that does not; compared to the other wall, the counts from the moving wall will be reduced due to this smearing effect, even though they have the same tracer concentration. Also, Galt et al. (*3*) have shown that due to partial volume effects (*4*) the change in myocardial counts throughout the cardiac cycle is proportional to the change in myocardial thickness. This proportionality has been used in both PET (*5*) and SPECT (*6*) for the assessment of regional myocardial thickening. There is also a direct dependence on the thickness of a wall and the counts that are recorded from that wall as well as a dependence between the degree of thickening and the counts recorded on an ungated emission tomogram. As pointed out by Schmarkey et al. (*7*) there is a significant effect that contractile dysfunction exerts on the ungated SPECT myocardial count (perfusion) distribution. This effect has profound significance when interpreting the change in defect size or severity between a stress and rest study and when imaging stunned or hibernating myocardium (*7*). Thus, the use of gated emission tomography should improve the accuracy with which count distribution within the image represents true myocardial perfusion distribution assuming that there is an adequate number of counts in these gated images. One should expect similar complications whether myocardial perfusion or metabolism is being evaluated with either PET or SPECT. Although simple to describe, the complications resulting from the attempt to assess myocardial count distributions from ungated studies and the full clinical impact of this improvement are still pending application of this gated technique in large patient populations with a variety of cardiac disease states.

**Ernest V. Garcia**
**Johnathan P. Vansant**
*Emory University School of Medicine*
*Atlanta, Georgia*

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