Thallium-201 in Myocardial Perfusion

The high incidence of ischemic heart disease has stimulated investigators to search for a safe, noninvasive, and reproducible technique to measure myocardial perfusion. Because of their concentration in the myocardium, the predominately intracellular cation potassium and its analogs have been under evaluation since 1958. The localization of these cations is probably based on the delivery of the radiopharmaceutical to the cellular site and the subsequent extraction of the cations by the sodium potassium ATPase system. The initial distribution of the tracers appears to be related primarily to the level of perfusion. In images obtained early after injection the areas of decreased activity seen on the scintiscans is assumed to relate to decreased perfusion in a particular volume of muscle. Cations that have been used for this purpose include potassium (K-42, K-43), rubidium (Rb-84), cesium (Cs-129, Cs-131, Cs-134m), and thallium-201 (Tl-201), and of these, thallium-201 possesses the best physical properties for imaging. Positron-emitting radionuclides such as N-13, C-11, and O-15 have been used but are not universally available. Iodine or technetium-99m labeled albumin microaggregates (MAA) measure perfusion but require direct injection into a coronary artery.

Thallium-201 is the present agent of choice to measure myocardial perfusion noninvasively and currently is being used in two different clinical settings. In patients with acute myocardial infarcts an important application is the detection of fixed changes in perfusion. Studies in a large series of patients have shown that perfusion defects will be observed in almost all cases of acute myocardial infarcts if the images are obtained in the first few hours following infarction. It must be stressed that localized reductions in thallium uptake represent defects in perfustion and that these thallium defects do not distinguish between myocardial ischemia, necrosis, or scar. When imaging patients with acute myocardial infarcts, the defect often appears larger than the actual area of necrosis due to associated ischemia and/or old infarction. After the first few hours thallium will enter into damaged tissue proportional to collateral blood flow to this area. The combination of thallium-201 and technetium-99m stannous pyrophosphate scintiscans should help define what part of the decreased perfusion is due to necrotic tissue and what part might be due to myocardial ischemia. Another important application of thallium-201 perfusion imaging is the evaluation of coronary perfusion reserve (exercise testing). This test is based on the fact that with high grades of obstruction adequate perfusion to the myocardium can exist at rest. In the face of increased demand for perfusion during exercise, however, blood flow to the normal myocardium increases while those areas perfused by arteries compromised by stenosis are unable to compensate for the increased demand. This form of noninvasive detection of coronary artery disease appears more accurate than ECG exercise testing alone. In identifying the presence of coronary artery disease a combination of the exercising techniques is more accurate than either technique alone.

Many good articles have been published during the past two years on the use and biological properties of thallium-201, and one of these is that of Leanaers et al. on page 509 of this issue. Thallium-201 myocardial perfusion imaging is now considered a useful clinical test for the purposes suggested above and no longer is deemed simply a research tool.

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