Vasodilator Myocardial Imaging

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The use of vasodilator thallium-201 myocardial imaging, although still investigational, is finding widespread application.

The principle of vasodilator thallium-201 myocardial imaging was first put forward by Strauss and Pitt, who used dimethyladenosine in dogs with experimental coronary artery narrowing. They demonstrated that dimethyladenosine increased coronary blood flow and thallium-201 uptake to normal areas of myocardium, whereas areas of myocardium served by a coronary artery with hemodynamically significant coronary artery narrowing had a reduced flow reserve and hence less thallium-201 uptake. Subsequent studies with dipyridamole, which blocks cellular uptake of adenosine, have demonstrated that the resultant arteriolar vasodilatation can induce myocardial ischemia by causing a coronary “steal.” Gould et al were the first to apply this principle to clinical investigation using dipyridamole. Over the past decade, dipyridamole thallium-201 myocardial imaging has been found useful in evaluating patients with peripheral vascular disease who cannot perform an adequate submaximal exercise test to detect myocardial ischemia. Use of this test before elective vascular surgery has allowed the detection of patients with significant coronary artery narrowing and protection of areas of jeopardized myocardium by appropriate medical therapy, PTCA, or bypass graft surgery, thereby diminishing the morbidity and mortality associated with vascular repair in these high-risk individuals. Dipyridamole thallium-201 myocardial imaging is also increasingly used to evaluate patients with acute myocardial infarction before hospital discharge in an attempt to select patients for coronary angiography, possible PTCA, or coronary bypass graft surgery. The excellent sensitivity and specificity of dipyridamole thallium-201 myocardial imaging and relative ease of administration of intravenous dipyridamole has suggested that vasodilator thallium-201 myocardial imaging might be a useful substitute for exercise thallium-201 myocardial imaging. However, the risks of inducing a coronary steal and death with an arteriolar vasodilator such as dipyridamole makes the routine substitution of vasodilator myocardial imaging with dipyridamole for exercise stress testing unlikely.

The report by Verani et al which demonstrates an 83% sensitivity and 94% specificity for vasodilator thallium-201 myocardial imaging with adenosine, is a further modification of the concept of vasodilator thallium-201 myocardial imaging and is potentially an important advance. Although the side-effect profile of adenosine is, as expected, similar to that of dipyridamole, its shorter half life in the plasma could prove to be an advantage. The fact that Verani et al did not have to use aminophylline to counteract any of the transient side effects encountered with adenosine is encouraging and suggests that adenosine may have a potential advantage over dipyridamole. Clearly, before any decision is made concerning the relative efficacy and safety of vasodilator thallium-201 myocardial imaging with adenosine versus dipyridamole, direct comparative trials will need to be carried out in a prospective manner. The most important question to the clinician, however, may not necessarily be whether vasodilator thallium-201 myocardial imaging with adenosine is superior to that with dipyridamole, but whether vasodilator thallium-201 myocardial imaging is superior to other nonexercise techniques for the detection and evaluation of myocardial ischemia.

Myocardial ischemia and/or decreased coronary artery flow reserve may be detected by administration of an arteriolar vasodilator such as adenosine or dipyridamole or by techniques that increase myocardial oxygen demand with development of regional myocardial wall motion abnormalities such as the cold pressor test, hand grip, atrial, or esophageal pacing, or intravenous dobutamine infusion. Modalities other than thallium-201 myocardial imaging, such as echocardiography, can also be used to detect ischemia. Increasing experience with intravenous dipyridamole or dobutamine echocardiography suggests that its sensitivity and specificity may be comparable to that achieved by exercise thallium-201 myocardial imaging. A far larger number of patients will, however, need to be studied prospectively before the relative safety and true comparative efficacy of dipyridamole or dobutamine echocardiography can be determined. There are, however, a number of considerations that suggest that stress echocardiography with
dipyridamole, adenosine, or dobutamine, if it can be shown to have a similar safety and efficacy profile compared with vasodilator thallium-201 myocardial imaging, might be the preferred technique.

Although charges for noninvasive procedures vary from region to region, it is likely that the true cost to perform an intravenous vasodilator or dobutamine echocardiographic stress test will be considerably lower than that for vasodilator thallium-201 myocardial imaging. Vasodilator thallium-201 myocardial imaging with either adenosine or dipyridamole requires the purchase of a relatively expensive tracer, thallium-201, and, more importantly, requires considerable technician time required for the initial injection and imaging, as well as reinjection and/or reimaging during a second period of redistribution, whereas intravenous vasodilator or dobutamine echocardiography requires only a single infusion and imaging period. In addition to lower cost, intravenous vasodilator or dobutamine echocardiography allows a study of the time course of the development of myocardial ischemia and has the potential of providing the clinician with other valuable data for assessing a patient with suspected ischemic heart disease such as ventricular ejection fraction, wall thickness, diastolic function, and presence of hypertrophic cardiomyopathy, or with associated valvular dysfunction such as ischemic mitral insufficiency, which can be of major importance in the evaluation of patients with suspected ischemic heart disease for medical therapy or intervention.

Much progress has been made over the past decade in developing new noninvasive techniques and strategies for stress testing to detect and evaluate patients with suspected and proven ischemic heart disease. The task that lies ahead for the 1990s is to provide reliable data, which will enable the clinician to choose the most cost-effective way to evaluate a patient with suspected ischemic heart disease. It is no longer acceptable to use multiple imaging techniques on the same patient to provide redundant or complementary data. We need to choose and develop techniques that provide the maximum information that will be useful in clinical decision making and to demonstrate that the information provided effects a definable clinical outcome.

References
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