exercise and the heart

Prolonged Myocardial Ischemia after Intravenous Dipyridamole Thallium Imaging*

Marc K. Lewen, D.O.; Arthur J. Labovitz, M.D., F.C.C.P.; Morton J. Kern, M.D.; and Bernard R. Chaitman, M.D.

Intravenous dipyridamole thallium imaging is reported to be a safe test with minimal side effects. It has been proposed by some that the test simply dilates the coronary vessels without actually producing myocardial ischemia. In this report, we describe a patient who, following intravenous dipyridamole thallium imaging, developed severe myocardial ischemia which persisted for 90 minutes, requiring emergency coronary angioplasty to alleviate the ischemic insult. Sequential electrocardiograms and cardiac isoenzyme levels following coronary angioplasty were within normal limits. Thus, severe myocardial ischemia following intravenous dipyridamole testing can occur and emphasizes the importance of careful monitoring of these patients, particularly when the pretest risk of coronary disease is high.

Intravenous dipyridamole thallium imaging is a useful diagnostic and prognostic test in the assessment of patients with suspected or proven coronary artery disease. In standard intravenous doses, dipyridamole results in coronary vasodilation and enhances regional differences in myocardial perfusion in patients with obstructive coronary disease which can be detected by thallium imaging. Several authors have reported that the test is safe and side effects easily reversed with intravenous aminophylline. Homma et al reported absence of major ischemic cardiac pain, myocardial infarction, severe arrhythmias, or death in a selected series of 293 consecutive patients referred for intravenous thallium imaging at the Massachusetts General Hospital; however, intravenous dipyridamole-induced angina accompanied by ischemic ST-T wave abnormalities or new wall motion abnormalities detected by echocardiography clearly demonstrates that the test can be associated with significant myocardial ischemia. In this report, we describe a patient who, following intravenous dipyridamole thallium imaging, had a severe myocardial ischemic response which required emergency coronary revascularization.

CASE REPORT

This 59-year-old woman with a ten-year history of atypical chest pain was admitted to the medical intensive care unit for evaluation of two hours of prolonged chest pain considered atypical for angina pectoris. Pertinent past medical history included an 80 pack-year smoking history, hypertension, and osteoarthritis. The findings from the initial cardiovascular examination were within normal limits, and the electrocardiogram on admission was normal. The patient became asymptomatic shortly after admission, and nadolol (40 mg OD) and sublingual nitroglycerin were prescribed. Serial ECGs and sequential cardiac enzyme levels were unremarkable. An echocardiogram revealed normal left ventricular wall motion. The patient remained asymptomatic for 72 hours and was referred for an intravenous dipyridamole thallium study because of serious orthopedic limitations.

Dipyridamole (0.56 mg/kg) was infused intravenously over four

![Pre-infusion vs Post-infusion](image)

**FIGURE 1.** At left is normal 12-lead ECG before intravenous dipyridamole infusion. Eight minutes following infusion, 1 mm of horizontal ST-segment depression is seen in inferolateral leads.
the patient noted mild chest discomfort, at which time the ECG revealed evidence of inferolateral ischemia (Fig 1). The initial set of thallium images were obtained as aminophylline (125 mg) was administered twice, with a slight decrease in the intensity of chest discomfort. Several sublingual doses of nitroglycerin (0.2 mg) were subsequently administered, with complete resolution of the chest discomfort over the ensuing 30 minutes. A two-dimensional echocardiogram recorded between sets of thallium images revealed new septal and apical hypokinesia compared to the echocardiogram on admission. The thallium images revealed an anteroseptal defect (Fig 2). Thirty minutes following the dipyridamole infusion, the patient again complained of chest discomfort. The ECG revealed an anteroseptal current of injury (Fig 3). The patient was returned to the intensive care unit and treated with intravenous nitroglycerin and sublingual nifedipine (10 mg). Emergency cardiac catheterization was performed because of persistent chest pain and electrocardiographic changes (Fig 4). The 95 percent proximal left anterior descending lesion was successfully dilated to a residual luminal diameter of 30 percent, with resolution of symptoms. The time from angina and anterior ST-segment elevation changes to the time of revascularization was approximately 90 minutes. Following angioplasty the patient remained asymptomatic, with negative serial creatine kinase isoenzymes, normalization of the ECG, and nor-

**FIGURE 2.** Thallium images immediately after infusion reveal decreased counts in anterior, septal, and anterolateral region of heart (arrows). minutes, followed by isometric handgrip exercise at 25 percent of maximum voluntary contraction for an additional three minutes. Four minutes following completion of the infusion of dipyridamole, 2 mCi of thallium 201 was injected intravenously and the heart imaged in three standard views. The heart rate increased from 70 to 85 beats per minute, and systolic blood pressure decreased from 186 to 164 mm Hg. Immediately prior to obtaining the first thallium image,

**FIGURE 3.** Thirty minutes following dipyridamole infusion, ST-segment elevation and symmetric peaked T waves are seen in leads V1 to V4 and aVL, with 1-mm horizontal ST-segment depression in leads 2, 3, and aVF.

**FIGURE 4.** Coronary angiogram (30 minutes after infusion) reveals eccentric 95 percent proximal left anterior descending coronary lesion (arrow; upper panel) and sequential 60 percent and 70 percent narowings (arrows; lower panel) of proximal and distal right coronary artery.
malization of regional and global wall motion assessed by echocardiography.

**Discussion**

Intravenous dipyridamole thallium imaging is reported to be a safe noninvasive test to assess coronary artery disease. In a consecutive selected series of 293 patients studied by Homma et al, only 26 percent of the patients developed chest pain, and 20 percent of the patients developed ST-segment depression. In this series, symptoms were easily reversed with a slow intravenous bolus of 50 to 200 mg of aminophylline, which was repeated within two to seven minutes if no improvement was noted; however, one patient with severe asthma whose theophylline was withheld for two days had a respiratory arrest requiring intubation during the dipyridamole infusion. A second patient had severe orthostatic hypotension resulting in syncope. Bayliss et al reported one case of ventricular fibrillation after intravenous dipyridamole infusion. There are few if any published reports of patients who have had a myocardial infarction or death using the dose of 0.56 mg/kg infused over four minutes.

Our patient represents an example of severe persistent myocardial ischemia following dipyridamole infusion which was not reversed with 250 mg of intravenous aminophylline and intravenous nitroglycerin infusion. The exact mechanism which created the ischemic response is unclear. Studies in animals and humans have demonstrated marked decreases in poststenotic intraluminal pressure with collapse of poststenotic segments following maximal coronary vasodilation. Thus, the potential for coronary arterial steal distal to the high-grade left anterior descending coronary stenosis in our patient may have caused the prolonged episode of myocardial ischemia. The development of ST-segment elevation in the anterior precordial leads suggests that the area of myocardial ischemia was most likely in the left anterior descending coronary distribution. Exercise-induced ST-segment elevation in non-Q wave leads is a specific marker for the territory of ischemic myocardium. Picano et al described 14 patients with exercise-induced ST-segment elevation in the absence of previous infarction who underwent intravenous dipyridamole echocardiographic imaging. In seven of the 14 patients, the dipyridamole infusion produced ST-segment elevation in the same leads as during exercise. Clearly, intravenous dipyridamole can induce severe transmural myocardial ischemia.

As of Jan 1, 1987, over 5,000 patients have undergone intravenous dipyridamole imaging procedures. A small number of deaths have been reported, at least two of which were the result of severe myocardial ischemia and necrosis (personal communication, Dr. Alan Ran-hosky, March 1987). Thus, although the overall risk of performing an intravenous dipyridamole study is very low, close supervision is necessary, with careful attention to manifestations of myocardial ischemia. This patient represents the only patient in our series of over 500 intravenous dipyridamole thallium tests who had an ischemic response severe enough to require emergency coronary angioplasty. We have not had any patients in our series who developed a myocardial infarction or death.

**References**