Myocardial perfusion imaging after transient balloon occlusion during percutaneous coronary interventions

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Background. **Myocardial perfusion imaging (MPI) is highly sensitive in detecting rest ischemia when the radiotracer is injected during the episode of ischemia. The frequency of abnormal MPI results after resolution of ischemia is not well defined. The aim of this study was to determine how long MPI results remain abnormal after transient coronary artery occlusion.**

Methods and Results. **Patients undergoing single-vessel percutaneous coronary intervention were injected with technetium 99m sestamibi at 30 to 60 minutes (group 1) (n = 20) or 90 to 120 minutes (group 2) (n = 10) after the last balloon inflation and 24 hours later. There were 30 men aged 59 ± 8 years. The culprit vessel was the left anterior descending artery in 14 patients and the right coronary artery in 13. The diameter stenosis was reduced from 76.1% ± 8.7% to 3.0% ± 6.4% ($P < .001$). The duration of balloon inflation was 40.3 ± 12.5 seconds. Chest pain or ST shifts occurred in 66% of patients. A perfusion defect in the territory of the culprit artery was detected in 3 of 20 patients (15%) in group 1 and in 0 of 10 patients (0%) in group 2 ($P = .3$). One of those three patients had a perfusion defect on MPI done 24 hours later, along with a regional wall motion abnormality on the 2 sets of images.**

Conclusions. **Abnormal perfusion is seen in a small percentage of patients at 30 to 60 minutes and in none at 90 to 120 minutes after a brief transient balloon occlusion. These results might have important implications in patient care. (J Nucl Cardiol 2007;14:221-8.)**

Key Words: Myocardial perfusion imaging • single photon emission computed tomography • ischemia • percutaneous coronary intervention

In the United States more than 6 million patients present yearly to the emergency department with chest pain symptoms indicative of acute myocardial infarction or ischemia, at an annual cost of $10 to $12 billion.[1] One proposed strategy for identifying patients with ischemic chest pain is to perform rest myocardial perfusion imaging (MPI) in the emergency department. Observational and randomized studies have demonstrated the usefulness of rest MPI in reducing unnecessary hospitalizations and allowing cost savings in patients with suspected ischemia, as compared with routine care.[2,3] Udelson et al[4] showed that sestamibi rest imaging within 3 hours of chest pain resolution reduced the rate of hospitalization from 52% to 42%.

Given that a high proportion of patients present to the emergency department after resolution of chest pain, the following question arises: How long after resolution of ischemia is MPI still useful? It is recognized that it is not always possible to establish the exact time of onset and resolution of ischemia. The aim of this study was to evaluate the prevalence of perfusion defects at 2 different time intervals after the last balloon occlusion of a coronary artery in men during a percutaneous coronary intervention (PCI). We hypothesized that the likelihood of perfusion defects developing when the tracer was injected after a brief (30-60 seconds) balloon occlusion is low.

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METHODS

Study Population

The study included 30 patients who underwent elective PCI of a single native vessel for clinical indications at the Birmingham VA Medical Center (Birmingham, Ala). Patients were excluded if they had any of the following: greater than 30% residual diameter stenosis after PCI, abnormal coronary flow (Thrombolysis in Myocardial Infarction [TIMI] grade of <3) by angiography at the conclusion of PCI, presence of ischemic symptoms or electrocardiographic (ECG) changes (or both) after the final balloon inflation, allergy to technetium 99m sestamibi, myocardial infarction within 24 hours of PCI, or evidence of scar in the distribution of the culprit coronary artery as evidenced by either Q waves on the electrocardiogram, abnormal wall motion on echocardiography, or a fixed defect on pre-PCI stress/rest MPI. The institutional review board approved the study protocol, and informed consent was obtained from each patient before enrollment. There were no complications.

PCI Procedure

The PCI procedure was performed for clinical indications according to current standards via the femoral approach. The procedural steps and number and duration of balloon inflations were selected at the discretion of the interventionalist. The duration of the balloon inflation was merely dictated by patient safety and institutional review board considerations of what is considered standard clinical practice. The number, duration, and maximal pressures of balloon/stent inflations were recorded. A 7-lead electrocardiogram was obtained in 10 patients and a 12-lead electrocardiogram was obtained in 20 patients during the last balloon inflation along with assessment of chest pain. Coronary angiography was performed in multiple views before and after PCI. The culprit vessel and lesion descriptors, such as reference diameter, minimal luminal diameter, lesion length, and pre- and post-PCI diameter and area stenoses, were analyzed via quantitative coronary angiography by an angiographer who was blinded to the results of MPI. Flow before and after PCI was assessed angiographically via the TIMI flow score. Cardiac markers were drawn serially at 0, 8, and 16 to 24 hours after PCI, and a 12-lead electrocardiogram was obtained immediately and 24 hours after PCI.

MPI Procedure

High-dose (25-40 mCi) Tc-99m sestamibi was injected at 30 to 60 minutes after the last balloon inflation in 20 patients (group 1) and at 90 to 120 minutes in 10 patients (group 2). A second high dose (25-45 mCi) of Tc-99m sestamibi was injected in all patients 18 to 24 hours after the last balloon inflation. Image acquisition was done approximately 60 minutes after tracer injection via a dual-head gamma camera according to accepted standards.[5] Attenuation correction was not performed.

MPI Interpretation

The images were coded so that the interpreter was blinded to the sequence of studies. The 2 studies, immediately after PCI and 24 hours later, were read blindly side by side. The interpretation addressed the presence, severity, and extent of abnormality.[6] The summed score based on 17 segments (scale of 0-3, where 3 is normal and 0 is absent perfusion) was determined in the 2 sets of images in each patient. The summed difference score, which reflects the difference between initial and late images, was determined in each patient. The size of the abnormality, based on the number of segments involved, was considered small if it involved 1 or 2 segments, moderate if it involved 3 to 5 segments, and large if it involved more than 5 segments. Wall motion (scale of 0-3, where 0 is dyskinetic and 3 is normal) and wall thickening (scale of 0-3, where 0 is absent and 3 is normal) were assessed by use of the 17-segment model. Transient ischemic dilatation, lung-heart ratio, and left and right ventricular sizes were also assessed. The left ventricular ejection fraction was measured quantitatively from the gated images.[5]

Statistical Analysis

Statistical analysis was performed with SPSS software (version 10.05.5; SPSS, Chicago, Ill). Results are expressed as percent frequency or mean ± 1 SD where appropriate. Categoric variables were assessed by a χ^2 test if the expected frequency in any cell was 5 or greater and by a 2-tailed Fisher exact test if the expected frequency was less than 5. Continuous variables were assessed by a Student *t* test. A 2-tailed *P* value of <.05 was considered statistically significant.

RESULTS

Clinical Characteristics

The baseline characteristics are listed in Table 1. All patients were white men. The presenting diagnosis was class 3 or 4 angina in 73% of patients, and 70% of patients had stress MPI before PCI. All patients who had a history of myocardial infarction had stress MPI preceding PCI that did not show scar in the distribution of the coronary artery that underwent intervention.

Procedural Characteristics

The angiographic results are listed in Table 2. The mean diameter stenosis was 76.1% ± 8.7% (range, 60%-90%) before PCI and was reduced to 3.0% ± 6.4% after PCI ($P < .001$). Angiographically visible collaterals to the culprit artery were not seen in any patient. All patients underwent successful angioplasty and stenting of a single vessel (left anterior descending artery territory in 47%, right coronary artery territory in 43%, and left circumflex artery territory in 10%) without procedural