Thallium-201 Scintigraphy for Detection of Multivessel Disease in Patients with Prior Inferior Myocardial Infarction*


In order to compare the effectiveness of thallium-201 (201Tl) myocardial perfusion scintigraphy and the exercise electrocardiogram for identifying patients with multivessel coronary artery disease, these noninvasive tests and coronary arteriography were performed in 89 patients with prior inferior wall myocardial infarction. Eighty patients performed an adequate exercise test (angina, ST-segment depression or achievement of 85 percent maximum age-predicted heart rate). Of these 80 patients, coronary angiography documented multivessel disease in 57 and single-vessel disease in the remaining 23. Of the 57 patients with multivessel disease, 201Tl correctly predicted multivessel disease in 58 percent and the exercise ECG was positive in 63 percent. Of the 23 patients with single vessel disease 201Tl was negative for multivessel disease in 91 percent, while the exercise ECG was negative in only 52 percent. For detecting multivessel disease, combining the two tests increased the sensitivity to 82 percent, but decreased the specificity to 48 percent. The predictive value of positive 201Tl for multivessel disease was 94 percent as compared to 76 percent for the exercise ECG. Thallium-201 identified disease of the left anterior descending vessel in only 33 percent of 42 patients with disease in this vessel. These data suggest that in patients with previous inferior myocardial infarction, both 201Tl and exercise ECG have limited clinical value for predicting multivessel disease. However, unlike exercise ECG, 201Tl is highly specific and, when positive (perfusion defects in more than one vascular segment), highly predictive for multivessel disease.

Survivors of myocardial infarction represent a discrete subset of patients with coronary artery disease and they have a variable incidence of multivessel disease (MVD).1,2 Since the long-term prognosis in patients with coronary artery disease depends upon the number of diseased vessels,4,5 accurate characterization of the extent and location of coronary artery disease by a noninvasive test would be very helpful in identifying patients for further invasive studies, ie, coronary angiography. Myocardial perfusion imaging with thallium-201 (201Tl) has been widely reported as being superior to the standard exercise electrocardiography for the detection of coronary artery disease.6,9 Since the segmental myocardial perfusion abnormalities revealed by 201Tl imaging have been shown to correlate well with obstructive disease in the corresponding major coronary arteries,10 the present study was designed to evaluate the diagnostic capability of 201Tl imaging for identifying multivessel disease in patients with previous myocardial infarction. We selected inferior myocardial infarction as the study subset since these patients represent a large and easily defined subgroup in whom accurate prediction of disease involving the left coronary artery is of great clinical importance.

Methods

Study Population

The study population was comprised of 89 men, ranging in age from 34 to 71 years (mean 52.4) who had sustained an isolated inferior myocardial infarction at least three months prior to the study. Patients with anterior myocardial infarction, valvular heart disease, unstable angina, and cardiomyopathy were excluded from the study. A detailed clinical history, physical examination, chest x-ray examination and standard 12-lead ECG were performed on all patients. Inferior myocardial infarction was documented in 80 patients by significant Q waves in leads 2, 3, and aVF of a standard 12-lead ECG, as defined by the Minnesota code criteria.11 The remaining nine patients had prolonged chest pain compatible with myocardial infarction and their left ventriculograms revealed akinetic or dyskinetic inferior segment suggesting the inferior wall as the location of their myocardial infarction. An informed written consent for exercise test, 201Tl myocardial perfusion study, coronary angiography, and left ventricular angiography was obtained in all patients.
Exercise Test

The exercise test was performed on the treadmill using a standard Bruce protocol. During the exercise period, a bipolar lead from the CM, position or 12-lead ECG was continuously monitored for ST-segment changes. The ECG and blood pressure by standard arm cuff were recorded at rest and during the last 30 seconds of each stage of the Bruce protocol. The patients exercised until they developed moderately severe angina, severe dyspnea, dizziness, or physical exhaustion. The ECG criteria for a positive test were a horizontal or downsloping depression of ST segments (≥1 mm for 80 msec) or slowly upsloping ST segment depressed ≥1.5 mm at 80 seconds after the J-point in at least three consecutive complexes. If the resting ECG already showed ST-segment depression, an additional 1 mm of ST segmental depression was required for the test to be positive. The occurrence of angina, positive ST depression and/or achievement of at least 85 percent of the maximum age-predicted heart rate were considered as evidence of an adequate exercise test.

Thallium-201 Myocardial Perfusion Scintigraphy

At the peak level of exercise, 1.5 to 2.0 mCi of carrier-free thallium chloride (New England Nuclear Corp., North Billerica, MA) was injected into the antecubital vein following which exercise was continued at the same peak level for 30 to 60 seconds. Myocardial perfusion imaging was begun within 10 minutes after 201Tl injection. Images were collected in anterior, 45° left anterior oblique (LAO), and 70° LAO projections using a low energy, all-purpose or high-resolution collimators and a 25 percent window peaked to the 69 to 83 keV x-ray emission. A total of 200 K counts was obtained in each view. These views were obtained by rotation of the camera head over the individual in the supine position to allow similar positioning in both the initial (immediate postexercise) and delayed imaging. A Searle Radiographics Pho Gamma IV camera or a General Electric data camera was used for imaging. The data were stored in a 64 x 64 matrix format using a PDP-12/40 computer (Digital Equipment Corp., Maynard, MA). The image data were filtered using a fast Fourier transform technique for image enhancement. All initial (immediate postexercise) data collection was completed within 30 minutes after 201Tl administration. Following a four-hour rest period, the patient returned and the delayed imaging was repeated using identical projections and techniques. Unprocessed and computer-processed images were qualitatively examined for the presence and location of perfusion defects and for any decrease in their size and intensity on delayed images by two independent observers who had no knowledge of the clinical status of the patients. In the event of disagreement, the final interpretation was arrived at by consensus or by a third opinion. Partial redistribution of 201Tl activity in the infarction zone on sequential imaging was considered evidence of peri-infarction ischemia.

The anterolateral, septal and anteroseptal segments were considered to be specific for the left anterior descending (LAD) artery, the posterolateral segment in the 45° LAO view for the left circumflex vessel (LCX), and the inferior segments for the right coronary artery (RCA) or dominant LCX (Fig 1). Apical segment was considered nonspecific for correlation with individual coronary arteries and was therefore excluded from analysis. For the purposes of this study, if the initial scintigrams showed a perfusion defect only in the inferior segment corresponding only to the prior inferior MI, 201Tl imaging was considered negative for multivessel disease (Fig 2A). The 201Tl myocardial perfusion study was considered positive for multivessel disease if the initial images displayed perfusion defects in at least two vascular segments (Fig 2B and 2C).

Coronary and Left Ventricular Angiography

All patients underwent standard right and left heart catheterization, left ventriculography (30° right anterior oblique and 60° LAO projection), and selective coronary cineangiography. The left ventriculogram was filmed in the 9-inch mode at 60 frames/second following the injection of 40 to 50 ml of contrast medium (Renografin 76) in each view. Coronary cineangiograms were filmed in the 6-inch mode in multiple views at 60 frames/second. The cineangiograms were reviewed for wall motion abnormalities and for the severity of coronary artery stenosis by two inde-
Table 1—Clinical, Exercise ECG, and 201TI Scintigraphic Findings in Eighty Patients with Previous Inferior Wall MI

<table>
<thead>
<tr>
<th>Severity of angina</th>
<th>MVD* (N = 57)</th>
<th>SVD† (N = 23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No angina by history</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Angina during exercise test</td>
<td>34</td>
<td>10</td>
</tr>
<tr>
<td>Positive exercise ECG</td>
<td>36</td>
<td>11</td>
</tr>
<tr>
<td>Exercise 201TI perfusion defects</td>
<td>57†</td>
<td>20‡</td>
</tr>
</tbody>
</table>

*MVD = multivessel disease
†SVD = single-vessel disease
‡26 patients showing peri-infarction ischemia
§6 patients showing peri-infarction ischemia

independent observers. When the observers disagreed, the final interpretation was arrived at by consensus or by a third opinion. Reduction (70 percent or greater) of the luminal diameter of a coronary artery was considered a significant stenosis. For the purposes of this study, stenosis of the coronary arteries in the following locations was considered: proximal and middle thirds of the LAD, the diagonal branches of LAD, proximal and midportion (before the origin of the last marginal branch) of LCX, marginal branches, and RCA proximal to the origins of the posterior descending and posterolateral branches. A lesion of the left main coronary artery with a dominant RCA was counted as two-vessel (LAD + LCX) disease and with a dominant LCX counted as three-vessel disease.

Statistics

For the purpose of this study, sensitivity, specificity, predictive values and accuracy for the identification of MVD were defined as follows:

Sensitivity = \( \frac{\text{True positive}}{\text{True positive + False negative}} \times 100 \)

Specificity = \( \frac{\text{True negative}}{\text{True negative + False positive}} \times 100 \)

Predictive value of a positive test = \( \frac{\text{True positive}}{\text{True positive + False positive}} \times 100 \)

Predictive value of a negative test = \( \frac{\text{True negative}}{\text{True negative + False negative}} \times 100 \)

Accuracy = \( \frac{\text{True positive + True negative}}{\text{True positive + False positive + True negative + False negative}} \times 100 \)

An analysis of differences between proportions was carried out.10

RESULTS

Eighty-nine patients with prior inferior myocardial infarction were studied. Eighty patients performed an adequate exercise test (development of angina, positive ST-depression, or achievement of at least 85 percent age-predicted maximum heart rate). The data from these 80 patients form the basis of further analysis (Table 1). Multivessel disease was found in 57 patients (three-vessel disease in 25, and two-vessel disease in 32) and single ves-

![Graph showing sensitivity of 201TI for detecting disease in infarct-related coronary arteries and coronary arteries remote from infarct site. RCA = right coronary artery; LCX = left circumflex; LAD = left anterior descending.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21321/ on 04/02/2017)
sels disease (SVD) was present in the remaining 23 patients (Table 1). Of the 57 patients with MVD, 12 were asymptomatic and 45 had exertional angina (18 in functional class 1, 17 in class 2, and 10 in class 3). Of the 23 patients with SVD, nine were asymptomatic and 14 had exertional angina (12 in class 1 and two in class 2). Thallium-201 scintigraphy identified the prior inferior myocardial infarction in all 57 patients with multivessel disease and in 20 of 23 patients with single vessel disease.

**Thallium-201 Scintigraphic Findings**

*Detection of individual coronary arterial lesions (Fig 3, Table 2):* The sensitivity for detecting disease in the infarct-related vessels, ie, RCA and LCX, was 98 and 93 percent, respectively (Fig 3). However, the sensitivity for detecting disease in the noninfarcted regions was comparatively lower (40, 37, and 33 percent for RCA, LCX and LAD, respectively, Fig 3).

Sensitivity for identifying disease in the individual arteries was significantly related to the severity of stenosis (Table 2). In patients with three-vessel disease, 95, 47 and 33 percent of severely stenosed (≥90 percent) RCA, LCX and LAD, respectively, were identified versus 50, 17 and 21 percent of moderately stenosed (70 to 89 percent) RCA, LCX and LAD, respectively. In patients with two-vessel disease (2VD), 100, 100 and 67 percent of severely stenosed RCA, LCX and LAD, respectively, were identified versus 100, 50 and 25 percent of moderately stenosed RCA, LCX and LAD, respectively. In patients with one-vessel disease (1VD), all vessels were ≥90 percent stenosed and 93 and 78 percent of RCA and LCX, respectively, were identified.

**Prediction of MVD (Tables 3 and 4):** Of the 25 patients with known 3VD, 201TI predicted 3VD in none, 2VD in 13, and 1VD in the remaining 12. Of the 32 patients with known 2VD, 201TI predicted 2VD in 20, and 1VD in the remaining 12. Of the 23 patients with known 1VD, 201TI correctly predicted 1VD in 18, falsely predicted 2VD in two, and was entirely normal in three.

Of the 57 patients with multivessel disease, 201TI was positive (perfusion defects in two vascular segments) in 33 (sensitivity 58 percent), exercise ECG was positive in 36 (sensitivity 63 percent), and at least one of the two tests was positive in 47 (sensitivity 82 percent). Of the 23 patients with single vessel disease, 201TI was negative for the purposes of this study (perfusion defect only in inferior

**Table 2—Degree of Coronary Artery Stenosis and 201TI Sensitivity**

<table>
<thead>
<tr>
<th>Vessel</th>
<th>Degree of Stenosis</th>
<th>3VD</th>
<th>2VD</th>
<th>1VD</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 25* (%)</td>
<td>N = 32* (%)</td>
<td>N = 23* (%)</td>
<td>N = 80* (%)</td>
<td></td>
</tr>
<tr>
<td>RCA</td>
<td>All vessels</td>
<td>22 (88)</td>
<td>26 (100)</td>
<td>13 (93)</td>
<td>61 (94)</td>
</tr>
<tr>
<td></td>
<td>&gt;90%</td>
<td>20 (95)</td>
<td>23 (100)</td>
<td>13 (93)</td>
<td>56 (96)</td>
</tr>
<tr>
<td></td>
<td>70-89%</td>
<td>2 (50)</td>
<td>3 (100)</td>
<td>0</td>
<td>5 (71)</td>
</tr>
<tr>
<td>LCX</td>
<td>All vessels</td>
<td>10 (40)</td>
<td>18 (86)</td>
<td>7 (78)</td>
<td>35 (64)</td>
</tr>
<tr>
<td></td>
<td>&gt;90%</td>
<td>9 (47)</td>
<td>15 (100)</td>
<td>7 (78)</td>
<td>31 (72)</td>
</tr>
<tr>
<td></td>
<td>70-89%</td>
<td>1 (17)</td>
<td>3 (50)</td>
<td>0</td>
<td>4 (33)</td>
</tr>
<tr>
<td>LAD</td>
<td>All vessels</td>
<td>4 (24)</td>
<td>8 (47)</td>
<td>0</td>
<td>14 (33)</td>
</tr>
<tr>
<td></td>
<td>&gt;90%</td>
<td>2 (33)</td>
<td>6 (67)</td>
<td>0</td>
<td>8 (53)</td>
</tr>
<tr>
<td></td>
<td>70-89%</td>
<td>4 (21)</td>
<td>2 (25)</td>
<td>0</td>
<td>6 (22)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>38 (51)</td>
<td>52 (81)</td>
<td>20 (87)</td>
<td>110 (68)</td>
</tr>
</tbody>
</table>

RCA = right coronary artery; LCX = left circumflex; LAD = left anterior descending; VD = vessel disease

*Number of patients.

Only significant p values are indicated.
Table 3—Assessment of the Number of Diseased Coronary Arteries by Exercise 201Tl Imaging

<table>
<thead>
<tr>
<th>Coronary Angiography</th>
<th>Exercise 201Tl</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Diseased Vessels</td>
<td>No Patients</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>32</td>
</tr>
<tr>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
</tr>
</tbody>
</table>

Table 5—Changes in Perfusion Defects on Sequential 201Tl Imaging in Patients with Multivessel Disease (N=57)

<table>
<thead>
<tr>
<th>Additional Segment</th>
<th>Fixed (%)</th>
<th>Reversible (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inferior Segment</td>
<td>31 (39)</td>
<td>12 (16) ↔</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>P&lt;0.005</td>
<td>P&lt;0.005</td>
<td></td>
</tr>
<tr>
<td>Reversible</td>
<td>26 (2)</td>
<td>2 (8) ↔</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>14</td>
<td>33</td>
</tr>
</tbody>
</table>

COMMENTS

There are conflicting reports in the literature regarding the sensitivity of 201Tl scintigraphy for predicting multivessel disease in post-MI patients.\cite{23-26} Whereas Massie et al\cite{22} and McKillop et al\cite{23} reported relatively low sensitivity values of 47 and 45 percent, respectively, for detecting multivessel disease, Dunn et al\cite{24} reported considerably higher sensitivity value of 85 percent. Rigo et al\cite{29} described a sensitivity of 74 percent for predicting multivessel disease in inferior myocardial infarction patients and only 10 percent in patients with anterior myocardial infarction. Gibson et al\cite{25} using a quantitative analysis of segmental 201Tl activity and washout, detected multivessel disease in only 62 percent of the patients. In the present study, qualitative interpretations of 201Tl scintigraphy correctly predicted multivessel disease in 33 of 57 patients with subsequently documented multivessel disease for a sensitivity of 58 percent (Table 4).

Thallium-201 scintigraphy failed to predict multivessel disease in 24 patients with known multivessel disease (Table 4). There are several likely possibilities explaining the failure of 201Tl imaging to detect multivessel disease in these patients. It is possible that the perfusion through the most severely obstructed coronary vessel becomes compromised first, giving rise to ischemia in the corresponding

Table 4—Diagnostic Ability of Noninvasive Testing for Detecting MVD in Patients with Prior Inferior MI (N=80)

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity for MVD (%)</th>
<th>Specificity for MVD (%)</th>
<th>Predictive Value for MVD</th>
<th>Accuracy for MVD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Positive Test (%)</td>
<td>Negative Test (%)</td>
</tr>
<tr>
<td>Exercise Tl-201</td>
<td>33 (58)</td>
<td>21 (91)</td>
<td>33 (94)</td>
<td>21 (47)</td>
</tr>
<tr>
<td></td>
<td>57</td>
<td>22</td>
<td>35</td>
<td>45</td>
</tr>
<tr>
<td>Exercise ECG</td>
<td>36 (63)</td>
<td>12 (52)</td>
<td>36 (76)</td>
<td>12 (36)</td>
</tr>
<tr>
<td></td>
<td>57</td>
<td>23</td>
<td>47</td>
<td>33</td>
</tr>
<tr>
<td>Combined</td>
<td>47 (82)</td>
<td>11 (48)</td>
<td>47 (80)</td>
<td>11 (52)</td>
</tr>
<tr>
<td></td>
<td>57</td>
<td>23</td>
<td>59</td>
<td>21</td>
</tr>
</tbody>
</table>

MVD = multivessel disease
MI = myocardial infarction
Only significant p values are indicated

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myocardial segment and also causing angina and/or ST segment depression. Angina will force the patient to terminate exercise and, at this level of stress, the perfusion in the vessel(s) with a lesser degree of stenosis may not have become compromised and consequently the corresponding myocardial segments may show normal ²⁰¹TI activity. The likelihood of this possibility is supported by the development of peri-infarction ischemia in 11 of 24 patients in whom ²⁰¹TI imaging was negative for multivessel disease. Furthermore, of these 11 patients, ten had angina and/or ST depression at peak exercise. Since the myocardial uptake of ²⁰¹TI indicates relative rather than absolute perfusion, the myocardial regions subserved by coronary vessels with a lesser degree of stenosis show more ²⁰¹TI activity relative to regions supplied by vessels with a more severe degree of stenosis, resulting in an underestimation of the number of diseased vessels. This possibility is supported by our finding that ²⁰¹TI scintigraphy did not detect disease in all three coronary arteries in any of the 25 patients with known three-vessel disease (Table 3). In the case illustrated in Figure four, with a comparable degree of stenosis in two vessels, perfusion is uniformly reduced, leading to an inability of ²⁰¹TI imaging to correctly predict multivessel disease. Rigo et al.¹⁸ reported that nonjeopardized coronary collateral vessels may provide an adequate amount of blood flow and account for a normal-appearing ²⁰¹TI scintigram in segments supplied by severely narrowed coronary arteries. In the present study, this factor did not appear to be responsible for negative ²⁰¹TI scintigraphs in patients with multivessel disease because, whereas collateral vessels to the coronary artery corresponding to the inferior MI (RCA or LCX) were visualized in the majority of patients, collateral vessels to stenotic arteries away from the inferior myocardial infarction were visualized in only four of 57 patients with MVD. Exercise ²⁰¹TI images revealed decreased perfusion in the distribution of narrowed coronary arteries in all of these four patients. Another possible explanation might be that patients with negative ²⁰¹TI images for multivessel disease did not achieve an optimal level of exercise to induce myocardial ischemia. However, it appears unlikely since, at the time of ²⁰¹TI administration, 54 percent of the patients with ²⁰¹TI images negative for both multivessel disease and peri-infarction ischemia had developed angina and/or ST depression, and the remaining patients had achieved ≥85 percent of the maximum age-predicted heart rate.

Although the sensitivity of ²⁰¹TI imaging for predicting multivessel disease was low, the specificity was high (94 percent, Table 4). Two patients in whom ²⁰¹TI imaging was falsely positive for multivessel disease had occlusion of unusually large RCAs, resulting in perfusion defects in the inferior and posterolateral segments. Consequently, disease of the LCX was falsely predicted in these two patients.

A positive ²⁰¹TI test for MVD (perfusion defects in two vascular segments) had a high predictive value. Of the 35 patients with positive ²⁰¹TI images for multivessel disease, 33 actually had multivessel disease (positive predictive value of a positive test 94 percent, Table 4). Similar results have been reported by Lenaers et al.¹⁰ and Dunn et al.²⁴ However, a negative ²⁰¹TI test for multivessel disease (perfusion defect in only the inferior segment) revealed a low predictive value. Of the 45 patients with negative ²⁰¹TI images for multivessel disease, only 21 actually had single vessel disease (predictive value 47 percent, Table 4).

**Figure 4.** Underestimation of extent of coronary artery disease (CAD) by ²⁰¹TI imaging. In this patient with three-vessel CAD, in spite of an adequate level of exercise, as demonstrated by significant S-T depression and the development of angina, ²⁰¹TI scintigraphy showed a perfusion defect only in the inferior segment. It failed to identify disease of LAD and LCX vessels, probably due to uniform reduction of perfusion in the vascular beds of these vessels as they had the same degree of stenosis. LAO = left anterior oblique; Symp. Ltd. EX. = symptom limited exercise; POS. = positive; HR = heart rate; Cor. Ang. = coronary angiography; (P) = proximal; RCA = right coronary artery; LAD = left anterior descending; LCX = left circumflex.
Thallium-201 scintigraphy was significantly less sensitive in detecting disease in coronary arteries with moderate (70 to 89 percent) stenosis than in vessels with severe (≥90 percent) stenosis (Table 2). These findings are similar to other reports in the literature.12,22 In the present study, the overall sensitivity of 201Tl imaging to identify RCA and LCX disease was higher, and to detect LAD disease was lower as compared to previous reports.10,18-20 These discrepancies can be attributed to the different study populations. All patients in the present study had a previous inferior myocardial infarction, accounting for a higher incidence of severe RCA and/or LCX disease as compared to severe LAD disease (Table 2). Since infarct-related vessels (RCA and/or LCX) were identified in all 57 patients with multivessel disease, and since there were a large number of patients in whom LCX occlusion was responsible for inferior myocardial infarction, the sensitivity of 201Tl imaging for detecting LCX disease was considerably higher than reported in other studies. In addition, disease of the diagonal branch of the LAD was counted as LAD disease, which was not detected by 201Tl scintigraphy in any of these patients. Since it is generally believed that LAD disease is associated with a poor prognosis, the low sensitivity for identifying disease in this vessel in patients with prior inferior myocardial infarction was of great concern.

Sequential 201Tl Scintigraphy

Sequential 201Tl imaging demonstrated peri-infarction ischemia in six of 20 patients with SVD and 26 of 57 patients with MVD (Table 1). Peri-infarction ischemia has been described by Verani et al22 and Dunn et al24 who attributed it to collateral blood flow to the infarcted zone or to subtotal obstruction in the infarct-related coronary artery. In the present study, in patients with multivessel disease, reversible perfusion defects in vascular segments away from the infarcted zone were frequently associated with peri-infarction ischemia (Table 5). This finding results from an inadequate increase of flow in the stenotic coronary artery acting as a donor of the collateral flow to the infarcted segment. Thus, perfusion to the collaterals feeding the infarcted segment, as well as the specific segment supplied by the stenotic donor artery itself, might be inadequate during exercise and probably would be adequate during rest, resulting in reversibility of perfusion defects in both the infarcted and non-infarcted but ischemic segments. This finding would reinforce the hypothesis first advanced by Dunn et al.24

Of the 33 patients showing perfusion defects in a second vascular segment away from the infarcted segment, 14 defects (11 in LCX and three in LAD) in the second vascular segment were fixed and 19 were reversible on sequential imaging (Table 5). The fixed defects in the second vascular segment may be due to MI undetected by ECG, or may indicate severe ischemia which did not show any redistribution by four hours.28

Exercise ECG

Several recent reports have shown variable results regarding the ability of exercise ECG for predicting multivessel disease in post-MI patients.13,29-33 Chaitman et al,29 using a CM5 lead, reported a sensitivity of 67 percent for predicting multivessel disease in post-inferior myocardial infarction patients. Castellanet et al,12 using a three-lead system, reported a sensitivity of 87 percent and Dunn et al,24 using a 12-lead system, reported a sensitivity of 70 percent. In the present study, the sensitivity for predicting multivessel disease was 63 percent (Table 4) which is similar to that of Chaitman et al.29 The different sensitivities in the various studies may be explained by the use of different lead systems.

Several studies have shown exercise ECG to be highly specific (88 to 93 percent) for excluding multivessel disease in post-MI patients.13,29-33 In contrast, our study showed a low specificity of 52 percent (Table 4). Thus, of the 23 patients with single vessel disease, exercise ECG was negative in only 12 (Table 4). These results are similar to the report of Dunn et al24 who found that of the 12 patients with previous inferior myocardial infarction and single vessel disease, exercise ECG was negative in only five (specificity 42 percent). A relatively high incidence of positive exercise ECG patients with post-inferior MI with single vessel disease found in the present study suggests that the exercise-induced ST segment depression does not necessarily imply multivessel disease in post-infarction patients; however, it may indicate exercise-induced peri-infarction ischemia in some patients.

Clinical Implications

This study showed that both qualitative 201Tl scintigraphy and exercise ECG were limited by relatively low sensitivities (58 to 63 percent, respectively) for detecting MVD in patients with post-inferior myocardial infarction. However, in the detection of multivessel disease we found qualitative 201Tl scintigraphy to be (1) highly specific (91 percent), and (2) highly predictive for a positive test (94 percent). It is likely that sophisticated quantitative methods to evaluate 201Tl scintigraphy,
as developed by ourselves\textsuperscript{94} and others\textsuperscript{55,56} may improve the sensitivity value for detecting multivessel disease. It should be realized, however, that the majority of nuclear medicine laboratories still use qualitative interpretations of \textsuperscript{\textsuperscript{201}Tl} scintigraphy. In view of the fact that exercise ECG has not shown a high degree of reliability to localize myocardial ischemia,\textsuperscript{57} it appears that despite its limitations, qualitative interpretation of \textsuperscript{\textsuperscript{201}Tl} scintigraphy is a helpful diagnostic procedure to localize myocardial ischemia.

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