Exercise Testing and Left Main Coronary Artery Stenosis*

Can Patients with Left Main Disease Be Identified?

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Exercise testing is commonly used to evaluate patients with coronary artery disease who have serious anatomic characteristics. To study the characteristic exercise test variables in patients with left main coronary artery disease, the computerized data base of the Hungarian Institute of Cardiology Exercise Test Laboratory was used. Among 2,378 patients who had undergone a supine bicycle exercise test and who had abnormal coronary angiographic results, 65 patients with significant (>50 percent diameter narrowing) stenosis of the left main coronary artery were found. The 65 patients were subgrouped according to their previous history and other vessel involvement. Nine patients had isolated left main coronary artery disease and no myocardial infarction (group 1); 28 patients had left main coronary artery stenosis and another diseased vessel but no prior myocardial infarction (MI) (group 2); and 28 patients had left main coronary artery disease, another diseased vessel, and a prior MI (group 3). For comparison, the 27 patients selected to be the control group (group C) had no history of MI but had significant stenosis of both the left anterior descending and the left circumflex arteries. Exercise time, calculated oxygen consumption, maximal work load, time to ST depression, prevalence of ST segment depression, and maximal ST depression were similar in the groups. Maximal heart rate and double product were higher in group 1, but we could find no single variable or group of variables characteristic of left main coronary artery disease. (Chest 1991; 100:227-29)

The exercise test is the most commonly used diagnostic method in the evaluation of patients with chest pain syndromes. It is used both to identify patients with coronary artery disease and to assess the extent of coronary artery involvement. The significance of exercise testing in the detection of a high-risk subset of patients is widely debated. Patients with left main coronary artery disease usually have a better prognosis if treated surgically rather than medically. Patients belonging to this high-risk group should be identified by noninvasive means. The aim of the present study was to investigate the significance of the exercise test in identifying patients with left main coronary artery disease.

PATIENTS AND METHODS

The Hungarian Institute of Cardiology is the largest referral medical center in Hungary. Patients in whom there is suspicion of coronary artery disease are referred to our institute for coronary angiography based on clinical grounds. Patients with valvular heart disease and primary cardiomyopathy were excluded from the present study. All patients undergoing coronary arteriography underwent an exercise test before catheterization except in cases where resting pain and/or ST segment changes were observed.

To study the characteristic exercise test variables in patients with left main coronary artery disease, the Hungarian Institute of Cardiology Exercise Test Laboratory's computerized data base was used. Among 2,378 patients who had undergone supine bicycle exercise test and who had abnormal coronary angiographic results, 65 patients were found to have significant (>50 percent diameter narrowing) stenosis of the left main coronary artery. The 65 patients were subgrouped according to the result of coronary arteriography and a history of prior myocardial infarction (MI). Nine patients had isolated left main coronary artery disease and no prior MI (group 1); 28 patients had left main coronary artery disease and another diseased vessel, but no prior MI (group 2); and 28 patients had left main coronary artery disease, another diseased vessel, and with a prior MI (group 3). For comparison, the 27 patients selected as controls (group C) had no prior MI but had significant stenosis of the left anterior descending and left circumflex arteries.

Exercise Testing

Resting and posthyperventilation ECGs were obtained, followed by continuous graded upright cycle exercise testing until maximal effort had been reached. The work load was progressively increased in 25-W stages every 3 min. End points included severe angina pectoris, marked fatigue, claudication, dizziness or systolic hypotension and high-grade ventricular arrhythmia. ST-segment depression of at least 0.1 mV 80 ms after J point was regarded as a positive response if it was horizontal or downsloping.

Coronary Angiography

Cardiac catheterization was performed using the Sones or Judkins technique. Each major coronary artery was examined, and the presence or absence of a coronary obstruction was noted. If stenosis was present, the maximal percentage of luminal narrowing was recorded. Coronary artery disease was considered significant if at least 50 percent diameter narrowing in a major coronary arterial...
branch was observed. Left ventriculograms were obtained for all patients in the 30° right anterior oblique projection and the 60° left anterior oblique projection.

Statistical Analysis

For comparison of the continuous variables, Student's t test was used, and for discrete variables, χ² analysis was used.

RESULTS

Prevalence of Left Main Coronary Artery Disease

The prevalence of left main coronary artery disease was 2.7 percent (65/2,378); however, an isolated left main coronary artery disease lesion was found in only 0.4 percent (9/2,378) of the patients included in this study.

Age and Sex Distribution

Mean age and male-female ratio were similar in the various patient groups (Table 1).

Exercise Test Parameters

Exercise time, prevalence of ST segment depression, time to ST depression, mean ST depression in millimeters, and exercise-induced angina pectoris were also similar in the various groups. Maximal heart rate and double product were higher in patients with isolated left main coronary artery disease compared to other groups (Table 1). No single factor or combination of factors was found to be characteristic of left main coronary artery disease.

Table 1—Comparison of Age, Sex, and Exercise Test Variables in Different Patient Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>C</th>
</tr>
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<tbody>
<tr>
<td>Age, yr</td>
<td>47.7±8</td>
<td>51.7±9</td>
<td>52.9±10</td>
<td>51.2±9</td>
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<tr>
<td>Men/women</td>
<td>6/3</td>
<td>24/4</td>
<td>27/1</td>
<td>21/6</td>
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<tr>
<td>O₂ cons</td>
<td>16.8±5.5</td>
<td>14±6</td>
<td>13.6±4</td>
<td>15.4±6</td>
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<tr>
<td>MaxW</td>
<td>86±40</td>
<td>62±32</td>
<td>64±24</td>
<td>72±36</td>
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<tr>
<td>Exercise time</td>
<td>9±4</td>
<td>4±4</td>
<td>7±3</td>
<td>8±4</td>
</tr>
<tr>
<td>HR</td>
<td>86±20</td>
<td>81±15</td>
<td>81±20</td>
<td>76±14</td>
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<tr>
<td>MaxHR</td>
<td>139±16†</td>
<td>115±17</td>
<td>117±21</td>
<td>123±22</td>
</tr>
<tr>
<td>MaxBP (syst)</td>
<td>182±30</td>
<td>170±26</td>
<td>164±25</td>
<td>178±23</td>
</tr>
<tr>
<td>MaxBP (dias)</td>
<td>97±6</td>
<td>97±12</td>
<td>97±12</td>
<td>94±13</td>
</tr>
<tr>
<td>Double pr</td>
<td>25±5±4</td>
<td>20±7</td>
<td>19±6</td>
<td>22±6</td>
</tr>
<tr>
<td>Ex angina</td>
<td>4/9</td>
<td>13/28</td>
<td>21/28</td>
<td>13±27</td>
</tr>
<tr>
<td>ST depr</td>
<td>7/9</td>
<td>21/28</td>
<td>16/28</td>
<td>14±27</td>
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<tr>
<td>MaxST</td>
<td>2±0.6</td>
<td>1.8±1</td>
<td>1.6±0.7</td>
<td>1.6±0.5</td>
</tr>
</tbody>
</table>

*O₂ cons, calculated oxygen consumption, ml/kg body weight; maxW, highest work load in watts; exercise time, minutes; HR, resting heart rate (1/min); maxHR, highest HR (1/min) during exercise; maxBP (syst), highest systolic blood pressure (mm Hg) during exercise; maxBP (dias), highest diastolic blood pressure during exercise; double pr, double product (maxHRxMaxBP (syst)x10-4); ex angina, exercise-induced angina pectoris; ST depr, prevalence of ST depression in different patient groups; maxST, maximum ST depression in mm.

†Significant difference compared to groups 2, 3, and C.
‡Significant difference compared to groups 2 and 3.

DISCUSSION

The prevalence of left main coronary artery disease and isolated left main coronary artery disease in our population was very similar to data which were published by Cohen et al. Some studies have shown that variables of exercise test performance can be used to predict left main coronary artery disease. According to these studies, marked ST depression (>2 mm), long persistence of ST segment depression in the recovery period, and exertional hypotension were characteristic of left main coronary artery disease. However, in these studies, patients with left main coronary artery disease were grouped along with patients who had left main coronary artery disease and associated lesions. In our study, we compared exercise test variables in angiographically well-defined patient groups separating patients with isolated left main coronary artery disease from others with associated lesions as well and from patients with significant lesions on the branches of the left coronary artery (left anterior descending and circumflex arteries). In our study, the most important exercise test variables were similar in the various patient groups, and no single variable or groups of variables were found characteristic of left main coronary artery disease. Several previous authors came to similar conclusions.

We conclude that conventional exercise testing is an inadequate method to identify patients with left main coronary artery disease. Therefore, efforts should be made to find other noninvasive methods to separate patients at high risk. At present, coronary arteriography should be done in patients in whom there is a suspicion of left main coronary artery stenosis.

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