**INTRODUCTION**

In the emergency room, chest pain originates diagnostic uncertainty that is responsible for as many unnecessary admissions as mistaken discharges.\(^1\) The aim of chest pain units is to improve the effectiveness of the diagnosis of chest pain.\(^2,3\) Recently, early exercise stress testing has been added as a new diagnostic tool.\(^4-12\) The present study analyzes early exercise stress testing in patients seen in the emergency room for chest pain and evaluated according to a chest pain unit protocol.

**MATERIAL AND METHODS**

**Study group**

From 15 January 2001 to 1 March 2002, 917 consecutive patients with chest pain of possible coronary origin, as determined by the cardiologist on duty, were seen in the emergency room. Of them, 637 patients did not have ST-segment elevation and entered a chest pain unit protocol. The evaluation included \(a\) clinical history, assigning a score obtained with the Geleijnse scale\(^13\) (Appendix 1); \(b\) ECG in the emergency service, and \(c\) troponin I determination at arrival and 8 h and 12 h after the onset of pain. A selection was made of 142 patients (16% of the total
and 22% of patients with ST-segment elevation) to undergo early exercise stress testing (in the first 24 h). These patients met the following requirements: a) chest pain of uncertain coronary origin; b) ECG without ischemia or other repolarization abnormalities; c) normal troponin I, and d) sufficient physical capacity.

Exercise stress test

The Bruce protocol limited by symptoms was used with a treadmill. The result was considered positive if angina or ischemia (horizontal or descending ST-segment depression ≥1 mm, or ST-segment elevation), or inotropic failure appeared (fall of systolic arterial blood pressure [SBP]>10 mm Hg). The test was considered negative if the submaximum heart rate (85% of the expected rate for age) was reached without angina or ischemia. The result was defined as inconclusive if the test was negative, but not submaximum, or in the case of non-diagnostic changes in the ST segment (depression >0.5 mm but <1 mm, horizontal or descending without pain). After the test, patients with negative result were sent home. If the results were inconclusive, the acting cardiologist made the final decision. Patients with an early discharge were followed-up 10 and 30 days later in the outpatient clinic.

RESULTS

Characteristics of the population

The characteristics of the population are shown in Table 1. The patients assigned to the early exercise stress test were younger, had a lower prevalence of arterial hypertension, diabetes mellitus, and history of ischemic heart disease, and a lower pain score.

Results of exercise stress testing

There were no complications during the stress test. The test was negative in 82 patients (58%), inconclusive in 31 (22%), and positive in 29 (20%, none for inotropic failure). After the test, 92 patients were discharged (group I) and 50 were hospitalized (group II). The test was inconclusive in 10 patients of group I and in 21 patients of group II.

Cardiac episodes

Group I

Two patients presented cardiac episodes within 30 days; one was hospitalized in the first week for non-Q wave myocardial infarction with minimum elevation of markers (troponin I: 1.8 ng/mL), and the other was hospitalized in the fourth week for unstable angina that was treated with coronary angioplasty. The early exercise stress test had been inconclusive in both patients. No patient with a negative test had episodes within 30 days.

Group II

In the group of hospitalized patients, unstable angina was diagnosed in 30 cases (60%). In 29 patients with a positive test, ischemic heart disease was confirmed in 17 and excluded in 7 by coronary arteriography. In 5 patients, no studies other than the exercise stress test were made. If we exclude these 5 patients, the rate of false positives was 7 of 24 (29%). In 21 patients with an inconclusive test, ischemic heart disease was confirmed in 8 and excluded in 13. During admission, 3 patients had recurrent angina. Coronary angioplasty was performed in 8 patients and surgery in 6. No myocardial infarction or death occurred.

DISCUSSION

Selection of patients for early exercise stress testing

The selection of patients with chest pain to undergo early exercise stress testing requires an assessment of

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**TABLE 1. Risk factors and pain score in patients selected for the early exercise stress test (est) and in patients hospitalized without an early exercise stress test (no est)**

<table>
<thead>
<tr>
<th></th>
<th>Est</th>
<th>No est</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>61±11</td>
<td>69±12</td>
<td>.0001</td>
</tr>
<tr>
<td>Men</td>
<td>65%</td>
<td>63%</td>
<td>NS</td>
</tr>
<tr>
<td>Smokers</td>
<td>24%</td>
<td>18%</td>
<td>NS</td>
</tr>
<tr>
<td>AHT</td>
<td>47%</td>
<td>69%</td>
<td>.0001</td>
</tr>
<tr>
<td>DM</td>
<td>21%</td>
<td>33%</td>
<td>.007</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>51%</td>
<td>46%</td>
<td>NS</td>
</tr>
<tr>
<td>Family history</td>
<td>14%</td>
<td>10%</td>
<td>NS</td>
</tr>
<tr>
<td>History of ischemic heart disease</td>
<td>26%</td>
<td>57%</td>
<td>.0001</td>
</tr>
<tr>
<td>Score</td>
<td>8.6±1.7</td>
<td>11.5±2.7</td>
<td>.0001</td>
</tr>
</tbody>
</table>

DM indicates diabetes mellitus; AHT, arterial hypertension; NS, not significant.
the clinical history and absence of either ischemia in the ECG or elevation of the markers of necrosis. In relation to clinical history, the patients included received different labels such as atypical chest pain,\textsuperscript{4} unstable low-risk angina,\textsuperscript{7} atraumatic chest pain,\textsuperscript{10} chest pain of possible coronary origin,\textsuperscript{9} or patients with a probability of infarction <7% according to the Goldman algorithm.\textsuperscript{6,12} In our study, the pain score was lower in patients chosen for the exercise stress test, indicating that the clinical history was less typical in these patients. Altogether, 16\% of all patients with chest pain and 22\% of those without ST-segment elevation underwent the exercise stress test. These figures are similar to those reported by Lewis et al.\textsuperscript{9} In no case did complications occur during the test.

### Negative exercise stress test

Fifty-eight percent of the tests had a negative result. The rate of negative tests reported in the literature ranges from 38\% to 66\% (Table 2). The main contribution of the early exercise stress test is its high negative predictive valor, which was superior to 98\%, which allows patients to be discharged with a certain degree of safety from the emergency service.\textsuperscript{11} No patient with a negative test result presented episodes during the 30-day follow-up period.

### Inconclusive exercise stress test

Twenty-two percent of the tests were inconclusive. In the literature inconclusive results are reported in 23\% to 39\% (Table 2). Two patients discharged after an inconclusive test presented non-mortal episodes within the next 30 days. In the study by Diercks et al.,\textsuperscript{10} patients with inconclusive test results had a greater risk of episodes than those with negative test results.

### Positive exercise stress test

Positive tests results were obtained in 20\% of the total. The frequency of positive test results ranges from 7\% to 23\% in the literature. In our study the rate of false positive diagnoses was 29\%. In spite of the possible limitation of false positives, the prognostic value of the early exercise stress testing for patients with chest pain seen in the emergency service is comparable to that of the exercise stress test in outpatients with a risk of ischemic heart disease.\textsuperscript{10}

### Reduction of unnecessary admissions

Assuming that all the patients with chest pain of possible coronary origin would have been hospitalized, the early exercise stress test avoided the admission of 92 of 142 patients (65\%). Some studies defend the safety of a discharge from the emergency service when troponin concentration is normal.\textsuperscript{14} This criterion would have resulted in the discharge of 30 patients (21\%) with unstable angina in our series. Therefore, the exercise stress test is necessary for the final stratification of patients with chest pain and normal troponin concentration.

### CONCLUSIONS

In adequately selected patients, the early exercise stress test is safe and effective for the final
stratification of patients who seek emergency care for chest pain. The test must be negative to justify an early discharge.

**LIMITATIONS**

The small number of episodes – which could be expected when dealing with a low-risk population – and sample size, as well as the short follow-up, limit the conclusions of this study.

**REFERENCES**