Value of Early Exercise Stress Testing in a Chest Pain Unit Protocol

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Early exercise testing (first 24 hours) was evaluated in the stratification of patients seen in the emergency room for chest pain. One hundred and forty-two consecutive patients without ischemia in the ECG or troponin I elevation were included. Ninety-two patients were discharged after the exercise testing (group I, 82 negative and 10 inconclusive test results) and 50 patients were hospitalized (group II, 29 positive and 21 inconclusive test results). In group I, cardiac events (unstable angina and non-fatal infarction) occurred in the next 30 days of follow-up in 2 patients with inconclusive test results; no cardiac events occurred in patients with negative test results. In group II, unstable angina was diagnosed in 30 patients and 3 presented recurrent angina. There were no complications during exercise testing. In conclusion, early exercise testing is safe and useful in the stratification of patients seen in the emergency room for chest pain. Only patients with negative test results should be discharged early.

Key words: *Diagnosis. Exercise. Unstable angina. Myocardial infarction.*

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Valor de la prueba de esfuerzo precoz en un protocolo de unidad de dolor torácico

Se ha evaluado la prueba de esfuerzo precoz (primeras 24 h) en la estratificación de los pacientes que acuden a urgencias por dolor torácico. Se han incluido a 142 pacientes consecutivos sin isquemia en ECG ni elevación de troponina; 92 pacientes se dieron de alta tras la prueba (grupo I, 82 prueba negativa y 10 no concluyente) y 50 ingresaron (grupo II, 29 prueba positiva y 21 no concluyente). En el grupo I, 2 pacientes con prueba no concluyente presentaron episodios (angina inestable e infarto no mortal) a los 30 días; ninguno con prueba negativa tuvo episodios. En el grupo II se diagnosticó angina inestable en 30 pacientes y tres presentaron angina recurrente. No hubo complicaciones durante la prueba de esfuerzo. Se concluye que la prueba de esfuerzo precoz es útil y segura en la estratificación del paciente que acude a urgencias por dolor torácico. El alta precoz requiere que la prueba sea negativa.

Palabras clave: *Diagnóstico. Ejercicio. Angina inestable. Infarto de miocardio.*

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.

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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

ABBREVIATIONS

ECG: electrocardiogram
ST: ST segment

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

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)**

	Est	No est	*P*
Age	61±11	69±12	.0001
Men	65%	63%	NS
Smokers	24%	18%	NS
AHT	47%	69%	.0001
DM	21%	33%	.007
Cholesterol	51%	46%	NS
Family history	14%	10%	NS
History of ischemic heart disease	26%	57%	.0001
Score	8.6±1.7	11.5±2.70	.0001

DM indicates diabetes mellitus; AHT, arterial hypertension; NS, not significant.

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

TABLE 2. **Frequency of positive, negative and inconclusive exercise stress test results in different published series**

	Positive	Negative	Inconclusive
Lewis et al[5]	13%	64%	23%
Kirk et al[8]	13%	59%	28%
Farkouh et al[7]	–	64%	–
Lewis et al[9]	23%	38%	39%
Diercks et al[10]	3%	63%	34%
DeFilippi et al[12]	7%	66%	27%
Sanchis	20%	58%	22%

Appendix 1. **Score for chest pain**

Site	
Retrosternal	+3
Precordial	+2
Neck, jaw, or epigastrium	+1
Apical («below the left nipple»)	–1
Irradiation	
One of the two arms	+2
Shoulder, back, neck, jaw	+1
Characteristics	
Strongly oppressive	+3
Oppressive discomfort	+2
Stabbing pain	–1
Severity	
Severe	+2
Moderate	+1
Pain varies with	
Nitroglycerin	+1
Posture	–1
Breathing	–1
Associated symptoms	
Dyspnea	+2
Nausea or vomiting	+2
Sweating	+2
History of effort angina	+3

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,[4] unstable low-risk angina,[7] atraumatic chest pain,[10] chest pain of possible coronary origin,[9] or patients with a probability of infarction <7% according to the Goldman algorithm.[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.[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.[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,[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.[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.[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

1. Lee TH, Goldman L. Evaluation of the patient with acute chest pain. N Engl J Med 2000;342:1187-95.
2. Sanz G. Unidades de Dolor Torácico. Rev Esp Cardiol 2001; 1(Supl B): 67B-75B.
3. Bayón J, Alegría E, Bosch X, Cabadés A, Iglesias I, Jiménez JJ, et al. Unidades de dolor torácico. Organización y protocolo para el diagnóstico de los síndromes coronarios agudos. Rev Esp Cardiol 2002;55:143-54.
4. Kerns JR, Shaub TF, Fontanarosa PB. Emergency cardiac stress testing in the evaluation of emergency patients with atypical chest pain. Ann Emerg Med 1993;22:794-8.
5. Lewis WR, Amsterdam EA. Utility and safety of immediate exercise testing of low-risk patients admitted to the hospital for suspected acute myocardial infarction. Am J Cardiol 1994;74:987-90.
6. Zalenski RJ, McCarren M, Roberts R, Rydman RJ, Jovanovic B, Das K, et al. An evaluation of a chest pain diagnostic protocol to exclude acute cardiac ischemia in the emergency department. Arch Intern Med 1997;157:1085-91.
7. Farkouh ME, Smars PA, Reeder GS, Zinsmeister AR, Evans RW, Meloy TD, et al. A clinical trial of a chest-pain observation unit for patients with unstable angina. N Engl J Med 1998;339:1882-8.
8. Kirk JD, Turnipseed S, Lewis WR, Amsterdam EA. Evaluation of chest pain in low-risk patients presenting to the emergency department: the role or immediate exercise testing. Ann Emerg Med 1998;32:1-7.
9. Lewis WR, Amsterdam EA, Turnipseed S, Kirk JD. Immediate exercise tenting of low risk patients with known coronary artery disease presenting to the emergency department with chest pain. J Am Coll Cardiol 1999;33:1843-7.
10. Diercks DB, Gibler B, Liu T, Sayre MR, Storrow AB. Identification of patients at risk by graded exercise testing in an emergency department chest pain center. Am J Cardiol 2000;86:289-92.
11. Stein RA, Cahitman BR, Balady GR, Fleg JL, Limacher MC, Pina IL, et al. Safety and utility of exercise testing in emergency room chest pain centers. Circulation 2000;102:1463-7.
12. DeFilippi ChR, Rosanio S, Tocchi M, Parmar RJ, Potter MA, Uretsky BF, et al. Randomized comparison of a strategy of predischarge coronary angiography versus exercise testing in low-risk patients in a chest pain-unit: in-hospital and long-term outcomes. J Am Coll Cardiol 2001;37:2042-9.
13. Geleijnse ML, Elhendy A, Kasprzak JD, Rambaldi R, Van Domburg RT, Cornel JH, et al. Safety and prognostic value of early dobutamine-atropine stress echocardiography in patients with spontaneous chest pain and a non-diagnostic electrocardiogram. Eur Heart J 2000;21:397-406.
14. Ham ChW, Goldmann BU, Heeschen CH, Kreyman G, Berger J, Meinertz Th. Emergency room triage of patients with acute chest pain by means of rapid testing for cardiac troponin T or troponin I. N Engl J Med 1997;337:1648-53.