SCIENTIFIC LETTER

Exercise stress testing as a predictor of progression of early chronic Chagas heart disease

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It is estimated that about four million people have chagasic heart disease in Latin America. The early detection of those patients who are likely to progress to more severe disease is necessary for appropriate treatment management to prevent further cardiac damage. The detection of ventricular arrhythmias is regarded as an expression of cardiac involvement in chagasic patients[1] and it is a common finding during stress testing. The objective of this study was to ascertain whether stress testing has prognostic value for the progression of early chronic Chagas heart disease.

METHODS

Eight hundred and forty three patients with confirmed positive serology for *Trypanosoma cruzi* infection were seen between 1984 and 2003 at the Hospital Eva Perón, Buenos Aires, Argentina. All patients were evaluated with ECG, chest radiography, bidimensional echocardiography, and stress testing under basal conditions. Patients were grouped into four stages according to a modified Kuschnir classification.[2] Patients in groups 0 (normal ECG and chest radiograph) and I (abnormal ECG and normal chest radiograph) and aged 20–60 years were enrolled for a longitudinal 10 year follow up.

Patients in groups II (left ventricular (LV) enlargement) and III (heart failure) (79 patients) were excluded. Other exclusion criteria were reduced LV systolic function (26 patients), associated pathological conditions (92 patients), incomplete screening period (21 patients), and incomplete stress testing (38 patients). Patients were assessed longitudinally by ECG every six months (group 0) and four months (group I) and by evaluation of the cardiothoracic index from annual chest radiography.

ECG abnormalities were defined as those specific for Chagas disease as previously reported.[3] Cardiomegaly was diagnosed by a cardiothoracic index > 0.50. The clinic variables evaluated were age at admission, sex, specific ECG abnormalities, clinical group, and baseline LV diastolic diameter.

The primary outcome of the study was progression to a more severe stage of the disease. The appearance of new ECG abnormalities indicated a shift from group 0 to group I; LV dilatation indicated a shift from group I to group II (confirmed by echocardiography); and the development of heart failure indicated progression from group II to group III.

Stress testing was performed on a bicycle ergometer, in both continuous and stepwise modes, with progressive workload increments of 150 kilograms every three minutes. Leads DII, V1, and V5 were monitored during the test and recorded throughout at three minute intervals during exercise and for nine minutes in the recovery stage. Abnormalities of the stress testing were failure to increase in systolic blood pressure, chronotropic incompetence, and the presence of ventricular extrasystoles during both the exercise and the recovery periods. Ventricular arrhythmias were further divided into complex (non-sustained ventricular tachycardia and ventricular couples) and non-complex (monomorphic and polymorphic ventricular extrasystoles).

Cox regression analysis was used to assess the relation between the evaluated variables and clinical group changes (dependent variable). Multivariate analysis considered all the variables significant at $p < 0.05$ in the univariate analysis.

RESULTS

The baseline features of 587 studied patients were as follows: 234 were men (40%); mean (SD) age at admission was 42.33 (10.14); in group I, 177 (30%) had ECG abnormalities; and LV diastolic diameter was 48.21 (5.61) mm. Median follow up was 9.37 (interquartile range 5.30–14.96) years. Eighty two patients (14%) were lost to follow up during the study and none of the evaluated patients died during follow up.

Thirty two (5%) patients progressed to a higher clinical group: 21 of 410 patients in group 0 (17 to group I, one to group II, and three to group III) and 11 of 177 patients in group I (nine to group II and two to group III). Ventricular arrhythmias were observed in 132 patients: 108 had non-complex ventricular arrhythmias and 24 had complex ventricular arrhythmias.

Univariate analysis showed that age at admission, complex ventricular arrhythmias, and maximum heart rate differed significantly. Conversely, change of clinical group was unrelated to functional capacity, maximum workload, failure to increase systolic blood pressure, chronotropic incompetence, non-complex ventricular arrhythmias, symptoms, ECG abnormalities, and initial clinical group. Multivariate analysis

Table 1 Exercise test predictors of change in clinical group in patients with early chronic Chagas heart disease during a 10 year follow up

Clinical variables*	No change in clinical group	Change in clinical group	Hazard ratio	95% CI	p Value
Mean (SD) age at admission (years)	41.74 (9.97)	48.89 (10.22)	1.09	1.04 to 1.14	0.001
Median (interquartile range) maximum heart rate (beats/min)	150 (130–162)	130 (107–150)	0.99	0.98 to 1.01	0.54
Complex ventricular arrhythmias	17/555 (3%)	7/32 (22%)	3.99	1.54 to 10.3	0.004

*Only variables with significant differences in the univariate analysis were included in the multivariate analysis.

showed that complex ventricular arrhythmias and age at admission, but not maximum heart rate, predicted progression (table 1).

DISCUSSION

Sudden death and sustained or non-sustained ventricular tachycardia induced during exercise testing in patients with chagasic myocarditis has been reported.[4] However, the relation between ventricular arrhythmias detected during stress testing in patients with mild forms of Chagas disease and the progression of the cardiac disease has not been evaluated. In this study we report, for the first time, that complex ventricular arrhythmias observed during stress testing have prognostic value for the progression of early chronic Chagas heart disease.

Complex ventricular arrhythmias during stress testing are a clinical marker of the slow, continuous evolution of chronic myocarditis. Therefore, the early detection of ventricular dysfunction is relevant for the appropriate management of these patients, including closer follow up and, eventually, specific chemotherapy for *T cruzi* to prevent progression to more severe stages of cardiac disease.

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IMAGES IN CARDIOLOGY

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The ''butterfly'' sign of the undilatable lesion

The vast majority of patients undergoing percutaneous coronary intervention (PCI) these days are treated with stent insertion uneventfully. Often, in simple cases, pre-dilatation with a balloon is not even performed (so-called ''direct'' stenting). In more complex cases, varying degrees of resistance of the lesion to balloon expansion are experienced, and these may require multiple balloon pre-dilatations to higher pressure and larger sizes before the stent can be implanted. A truly undilatable lesion is an unpredictable, fearsome and, mercifully, rare finding. It is usually associated with visible calcification at fluoroscopy in the presence of severe, concentric, and advanced coronary atherosclerosis.

When encountered before stent insertion, the lesion may be treated with high pressure, non-compliant balloon inflation, upsizing of the balloon, cutting balloon deployment, ''focused force'' balloon/wire combinations, or rotational atherectomy.

We report a case in which a 61 year old woman presented with chronic stable angina and severe stenoses of the right coronary (RCA), left anterior descending (LAD), and circumflex (Cx) (arrow) arteries with a mild distal left main stenosis. After successful PCI of the RCA, the Cx was treated. The lesion in this vessel was only found to be undilatable after partial stent deployment—a potentially disastrous situation, in which a thrombogenic, unexpanded metal mesh is wedged in a stenosed vessel. Most of the therapeutic options listed above were not appropriate because of the presence of the stent. The lesion was utterly unyielding to 4 and 5 mm balloons at high pressure, but eventually responded to deployment of two simultaneous ''kissing'' 3 mm balloons at 22 atm, which gave the angiographic appearance of a butterfly. The patient went on to have the LAD treated at the same sitting. Abciximab was administered and she left hospital uneventfully the next day.

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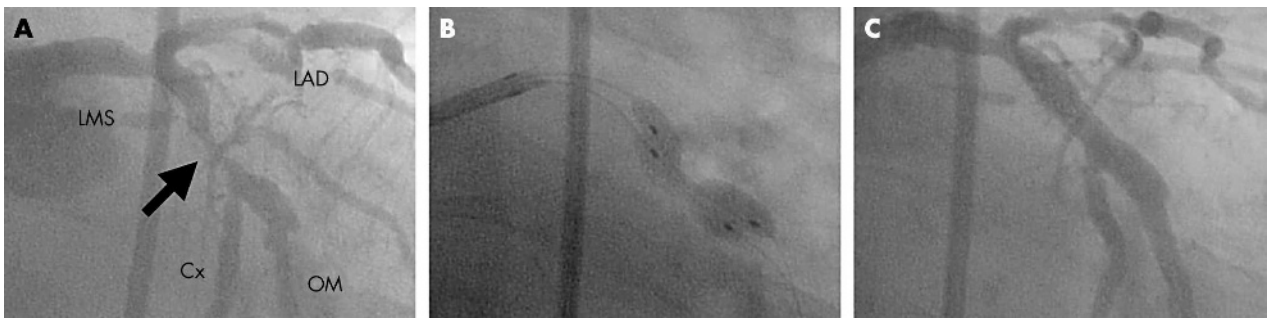

(A) The circumflex coronary artery of a 61 year old woman with three vessel disease was severely stenosed. The lesion was pre-dilated satisfactorily with a 2 mm balloon, so a 3.5 × 12 mm Liberte stent (Boston Scientific) was deployed. This could not be dilated with the deploying balloon, even at 20 atm pressure. Post-dilatation with 4.0 and 5.0 mm balloons to > 20 atm also failed to expand the stent. (B) Finally, a second guidewire was passed and two 3.0 mm balloons (one 15 mm long and the other 20 mm long) (Sequent, B-Braun) were inflated in ''kissing'' configuration to 22 atm, giving rise to the ''butterfly'' sign of the ''undilatable'' lesion. The lesion yielded just as the balloons burst. (C) Final result after post-dilatation with a 4.5 mm Grip balloon (Acrostak) at 25 atm.