Letter to the Editor

Functional capacity and risk stratification by the Six-minute Walk Test in Chagas heart disease: Comparison with Cardiopulmonary Exercise Testing

Henrique Silveira Costa a,⁎, Marcia Maria Oliveira Lima b, Giovane Rodrigo de Sousa a, Aline Cristina de Souza a, Maria Clara Noman Alencara a, Maria Carmo Pereira Nunes a, Manoel Otavio Costa Rocha a

a Postgraduate Course of Infectious Diseases and Tropical Medicine, Department of Internal Medicine, Medical School, Hospital das Clinicas, Federal University of Minas Gerais (UFMG), Belo Horizonte, Brazil
b Healthy and Biological Sciences Faculty, Physical Therapy School, Federal University of the Valleys of Jequitinhonha and Mucuri (UFVJM), Diamantina, Brazil

The Cardiopulmonary Exercise Testing (CPET) is considered the gold standard in the assessment of functional capacity (FC). Peak oxygen uptake (VO2peak) and the minute ventilation/carbon dioxide production slope (VE/VCO2 slope) are the two most frequently assessed CPET variables in heart failure (HF) patients [1]. However, the test is expensive, which limits its applicability in clinical routine and the Six-minute Walk Test (6MWT) [2] may be an alternative approach. The effectiveness of the 6MWT is well established in overall HF patients and the distance walked showed a moderate to strong correlation with VO2peak evaluated by CPET [3].

Chagas heart disease (CHD) represents an important cause of HF, with significant socioeconomic impact, worse prognosis compared to other cardiomyopathies and presents with some pathogenetic and clinical peculiarities [4]. In CHD patients, the 6MWT distance correlated with quality of life scores [5], hemodynamic and inflammatory markers [6] and improvements in the heart rate variability after aerobic training [7]. However, there are no available studies concerning CHD patients that verified the association between the distance walked during the 6MWT with CPET variables. Therefore, this study was designed to assess the correlation between the 6MWT distance and CPET variables in a wide spectrum of CHD, and also to determine an optimal cutoff value of 6MWT distance to identify functional impairment.

This cross-sectional study was approved by the institutional review committee and the subjects gave informed consent. Criteria for inclusion were the diagnosis of Chagas disease determined by positive serology, clinical, electrocardiographic or echocardiographic findings compatible with CHD, and sedentary lifestyle. Exclusion criteria were the presence of systemic or heart disease by any other causes, associated co-morbidities and the inability to perform the exercise tests.

The overall study population comprised patients with dilated left ventricle with impaired ventricular systolic function (dilated group) and patients with normal left ventricular dimensions and function (non-dilated group). The CPET was performed on a treadmill ramp protocol and the 6MWT was guided by current guidelines [2].

Chi-square, Mann–Whitney or independent t-test, as appropriate, and Pearson correlation test were performed for data analysis, with significance levels at 0.001% and 0.05%. A receiver–operator curve was constructed to determine the cutoff value of the 6MWT distance in the overall population with the best combination of sensitivity and specificity to identify functional impairment, defined as VO2peak Values below 20 mL·kg·min according to Webber classification [8].

Forty-one CHD patients (47.8 ± 8.3 years, 28 males) were evaluated. In the overall study population, the 6MWT distance correlated with VO2peak (r = 0.586; p < 0.001) but not with VE/VCO2 slope (r = −0.046; p = 0.776), Echocardiography parameters, 6MWT distance and CPET variables of the sample stratified according to left ventricular systolic function are presented in Table 1.

The 6MWT distance correlated with VO2peak in both dilated (n = 20) and non-dilated group (n = 21) (r = 0.612; p = 0.005 and r = 0.463; p = 0.035, respectively) (Fig. 1). No correlation was found between the distance walked and the VE/VCO2 slope in the dilated group (r = −0.322; p = 0.166) and in the non-dilated group (r = −0.104; p = 0.662).

The area under the ROC curve to identify a VO2peak of, at least, 20 mL·kg·min by 6MWT distance was 0.765 (CI 95%: 0.596–0.933) (Fig. 2). The optimal cut point value to identify functional impairment was a distance less than 522 m, with sensitivity and specificity of 72.4% and 81.8%, respectively.
To the best of our knowledge, this is the first study that demonstrated the association between the 6MWT distance and CPET variables in CHD patients. The following main findings are: (1) the significant correlation between the 6MWT distance and VO2peak in CHD patients, (2) the stronger correlation between 6MWT distance and VO2peak in CHD patients with impairment of ventricular function than those with preserved systolic function and (3) the 6MWT distance of 522 m is the optimal cutoff value to identify patients with functional impairment. These results have important clinical meaning in the setting of Chagas disease, since endemic areas are generally poor, have few resources and the maximal exercise test may not be available.

Aiming to verify the correlation between the 6MWT distance and VO2peak in HF patients, a recent systematic review[3] showed that most of the analyzed studies found a moderate to strong correlation between these variables. The moderate correlation found in the present study between the distance walked and VO2peak confirms the usefulness of the 6MWT in the evaluation of FC in HF patients regardless of etiology. Additionally, our results suggest that the 6MWT is better used when evaluating FC of patients with more severely impaired ventricular function. We hypothesized that the 6MWT methodology can underestimate the FC of patients with better systolic function. At 6MWT, patients are instructed to walk as fast as possible but without running[2] and it can be a limiting factor in the evaluation of patients with preserved systolic function, generally with higher FC. This fact does not occur during the CPET, which is a maximal test and the patient is encouraged to run if possible.

Recently, a previous study reported that the VE/VCO2 slope was the only variable assessed by CPET considered an independent predictor of survival in CHD patients[9]. The present study found no correlation between this variable and the 6MWT distance but, unlike the VO2peak, the VE/VCO2 slope is more related to the central function than to patient effort[10], which possibly explains the lack of correlation between these variables.

We also demonstrated that the 6MWT distance has good sensitivity and specificity in identifying patients with functional impairment. Other authors[11] have shown the effectiveness of the 6MWT in screening patients who were referred for heart transplantation with good sensitivity (80%) and specificity (83%). Thus, the 6MWT appears to be a simple, inexpensive and useful test for risk stratification based on functional impairment in the overall HF patients and also due to CHD.

In conclusion, the 6MWT appears to be an alternative tool in the assessment of FC in CHD patients and can also identify patients who have functional impairment with impact on the management of these patients.

Table 1
Characteristics of the CHD patients stratified according to left ventricular systolic function.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Dilated group (n = 20)</th>
<th>Non-dilated group (n = 21)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVEF (%)</td>
<td>38.00 (32.25–41.00)</td>
<td>63.00 (60.00–67.75)</td>
<td>0.001</td>
</tr>
<tr>
<td>LVDd (mm)</td>
<td>66.50 (61.00–71.25)</td>
<td>48.00 (44.50–52.00)</td>
<td>0.001</td>
</tr>
<tr>
<td>NYHA (n)</td>
<td>I (5); II (10); III (5)</td>
<td>I (16); II (4); III (1)</td>
<td>0.004</td>
</tr>
<tr>
<td>6MWT distance (m)</td>
<td>508.25 ± 82.41</td>
<td>571.24 ± 73.36</td>
<td>0.045</td>
</tr>
<tr>
<td>VO2peak (mL·kg·min)</td>
<td>21.92 ± 6.16</td>
<td>29.83 ± 7.29</td>
<td>0.001</td>
</tr>
<tr>
<td>VE/VCO2 slope</td>
<td>33.62 ± 5.65</td>
<td>30.26 ± 3.67</td>
<td>0.029</td>
</tr>
<tr>
<td>%HR predicted (%)</td>
<td>78.00 ± 13.87</td>
<td>87.89 ± 10.08</td>
<td>0.020</td>
</tr>
</tbody>
</table>

Data presented as mean and standard deviation (mean ± SD), median (MD) and interquartile range (25–75%) or absolute number. p value is the difference between dilated and non-dilated group and the values highlighted in bold are statistically significant (p < 0.05). LVEF = left ventricular ejection fraction, LVDd = left ventricular end-diastolic diameter, NYHA = New York Heart Association, 6MWT distance = distance walked in Six-minute Walk Test, VO2peak = peak oxygen uptake, VE/VCO2 slope = minute ventilation/carbon dioxide production slope, and %HR predicted = percentage of maximal heart rate predicted achieved in the effort.

Fig. 1. Correlation between the distance walked in 6MWT and peak oxygen uptake (peak VO2) (A) in the dilated group and (B) in the non-dilated group.

Fig. 2. Receiver-operating characteristic (ROC) curve representing the accuracy of distance walked in 6MWT to identify a VO2peak of, at least, 20 mL·kg·min.
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Conflict of interest

The authors report no relationships that could be construed as a conflict of interest.

References


