The 6-Minute Walk as an Appropriate Exercise Test in Elderly Patients With Chronic Heart Failure

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Background. The value of the 6-minute walk in a population of elderly patients with chronic heart failure (CHF) has not yet been established, as it has been in a younger population.

Methods. In a prospective trial, 2 exercise tests were compared: the 6-minute walk (6 MW) and a treadmill test with progressive increments in workload. 37 patients (mean age 81.3, SD 5.6 years): 11 untrained controls, 16 patients with New York Heart Association (NYHA) class II and 10 patients with NYHA class III participated. The main outcome measures were the distance walked in 6 minutes, the symptomatic VO₂ max in the progressive treadmill test and the degree of CHF as scored by the NYHA classification and the Boston Study Group (BSG) score.

Results. For both the 6 MW and the treadmill test there was a significant difference in distance between NYHA class II and III patients (p < .001), but not between the controls and NYHA class II patients. The distance walked in the 6 MW was well correlated with the distance walked in the treadmill test (p < .001). Eight participants (22%), however, were unable to perform this treadmill test and 6 participants (17%) covered very low distances compared to the 6 MW. The VO₂ max was lower in NYHA class III than in class II patients (p < .001). NYHA classification and BSG score correlated reasonably well.

Conclusion. A treadmill exercise test with VO₂ max measurement in elderly patients with CHF is difficult to accomplish. On the contrary, the 6 MW gives a good impression of the remaining exercise capacity. It is well correlated with the treadmill test. The 6 MW is well tolerated by elderly patients and differentiates between NYHA classes II and III.

Untrained controls could not be differentiated from NYHA class II patients.

CHRONIC heart failure (CHF) is an important and frequent health problem, affecting about 1% of the population. Its prevalence increases with age, making it the most frequent diagnosis at dismissal from the hospital and the first cause for mortality in the elderly (1–3). For this steadily growing population, it would be helpful to have a well tolerated, simple and inexpensive exercise test in order to evaluate the degree of CHF. A large number of elderly people feel uncomfortable in the classic exercise tests. Lipkin et al. (4) described a 6-minute walk (6 MW), which is well supported and capable of differentiating the severity of the heart failure. This 6 MW measures the maximal distance covered in 6 minutes, which is mainly limited by symptoms of fatigue and dyspnea (5–6). The 6 MW corresponds well to a realistic effort, as performed in daily life (7). Hence, this test could give an objective impression of the remaining exercise capacity. It is well correlated with the treadmill test. The 6 MW is well tolerated by elderly patients and differentiates between NYHA classes II and III.

Methods

Subjects. — Patients older than 70 years of age with symptomatic heart failure [New York Heart Association (NYHA) class II and III] for 6 months or more were included. Echocardiography and isotopic left ventricular evaluation were performed to document the clinical diagnosis. Exclusion criteria were other pathological conditions which could influence exercise performance, such as angina pectoris, arrhythmia, electrolyte disturbances, obstructive valve disease, pulmonary disease, claudication, and invalidating orthopaedic disease. Advanced CHF, rated as NYHA class IV, making exercise impossible, was also an exclusion criterion. As controls, untrained persons were recruited from among the patients staying in the hospital, but not presenting any sign of CHF, nor any of the above mentioned exclusion criteria. They were partly on the ophthalmology ward, awaiting a surgical procedure, and partly on the geriatric ward, undergoing a check-up unrelated to any exercise incapacity.

Evaluation methods. — In order to estimate the severity of the CHF, all patients were scored according to the New York Heart Association (NYHA) score (13) and to the Boston Study Group (BSG) protocol (14–15). The latter takes into account the history, the physical examination, and the chest x-ray: 1 to 4 points are attributed for each item, with a total maximum of 12 points; 8 points or more certifies the diagnosis, and between 5 and 7 points the diagnosis is probable.

Isotopic and echocardiographic left ventricular ejection fraction was evaluated.

The 6 MW (4) was performed in a 60 meters long, circular hospital corridor. We instructed participants to walk as quickly as possible to cover the longest distance possible.

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within 6 minutes. During the walk, they were accompanied. At the end of the test, the patients had to have the impression that they could not have gone any further. Blood pressure and heart rate were noted before and after the exercise.

The treadmill (Rodby) was performed on another day, after the patients made acquaintance with the procedure. No ramp was used because this was considered to be too difficult for elderly patients. A conventional exercise program was used, starting initially slowly at 1 km/h (16 m/min) and progressively accelerating with increments of 0.5 km/h every 2 minutes (16). The test was continued until volitional fatigue or dyspnea occurred and made further effort impossible. The maximal oxygen uptake was the O₂ consumption at the end of this symptom limited test and was called symptomatic VO₂max. During the test, oxygen uptake was measured using an Oxycon Sigma meter. Blood pressure (BP), heart rate, and electrocardiogram were monitored. BP and heart rate were recorded immediately before and after the exercise.

Both the 6 MW and the treadmill test were conducted by a nurse unaware of the diagnosis nor of the degree of CHF. The time was called out every 2 minutes and patients were encouraged every half a minute in both tests (17). At all times a physician was present. The patients were randomly assigned to first 6 MW or treadmill. The Ethical Committee approved the study, and informed consent was obtained from all patients.

Statistical evaluation. — All means are given with the standard deviation (SD). For comparison of means, Student t-test was used, and where appropriate, a paired t-test was performed. Correlation coefficients were calculated for continuous variables. Nonparametric variables were compared with the Kendall test.

RESULTS

We studied 37 patients (22 women and 15 men): 16 with NYHA class II, 10 with NYHA class III, and 11 controls. The mean age of the patients was 81.3 years (SD 5.6), with a median of 82 years. Ages were between 70 and 90 years. The NYHA classification and the BSG score correlated well (Kendall's Tau = 0.796; p < 0.001). The isotopic LVEF was 36 ± 18% in NYHA II patients and 30 ± 18% in NYHA III patients. The distances in the 6 MW were not related to resting left ejection fraction or to echocardiographic determinants.

All participants were able to terminate the 6 MW. The results, according to NYHA classes, are shown in Table 1. In NYHA class II the patients were slightly older than in the other classes. In all groups the variability of the distance was important. Nevertheless, there was a striking significant difference in mean distance between NYHA class II and III (p < 0.001) and between controls and NYHA class III (p < 0.001). The difference in mean distance walked between NYHA II and controls was small. There was a significant rise in heart rate frequency and systolic blood pressure, indicating that the participants made a considerable effort. All participants were able to walk until the end of the 6-minute period. In Figure 2, the individual results obtained in the 6 MW are compared for NYHA and BSG score.

The results of the treadmill test with progressive increments of workload are given in Table 2. Eight participants (22%) were unable to perform this test. Especially problematic were the fear of falling and the speed of the treadmill. Asked for their preference, all patients declared preferring the 6 MW. The distances for both groups were significantly different from NYHA class III patients (p < 0.02). The heart rate at rest, before the start of the treadmill test, was significantly higher (p < 0.001) than before the start of the 6 MW. Again, after the test, there was a significant rise in heart rate frequency and systolic blood pressure, indicating that the subjects made an important effort. There was a significantly lower symptomatic VO₂max for the NYHA class II patients (p = .032), compared to the NYHA class II patients. The respiratory exchange ratio at symptomatic VO₂max was .90 ± .07 for controls; .86 ± .07 for NYHA class II patients, and .84 ± .08 for NYHA class III patients.
Table 2. The Treadmill Test. Distance Walked, Heart Rate and Blood Pressure (BP) Changes, and Maximal Oxygen Uptake ($\text{VO}_2\text{max}$) Expressed as Mean (SD) for Patients With Chronic Heart Failure and Controls

<table>
<thead>
<tr>
<th>Number*</th>
<th>Controls</th>
<th>NYHA II</th>
<th>NYHA III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (m)$^+$</td>
<td>9</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Heart rate (beats/min) before exercise</td>
<td>242 (141)</td>
<td>323 (224)</td>
<td>131 (91)</td>
</tr>
<tr>
<td>Heart rate (beats/min) after exercise</td>
<td>94 (26)</td>
<td>86 (14)</td>
<td>82 (15)</td>
</tr>
<tr>
<td>Systolic BP (mmHg) before exercise</td>
<td>128 (24)</td>
<td>126 (30)</td>
<td>111 (21)</td>
</tr>
<tr>
<td>Systolic BP (mmHg) after exercise</td>
<td>136 (16)</td>
<td>139 (20)</td>
<td>145 (16)</td>
</tr>
<tr>
<td>% increase of the mean heart rate before exercise</td>
<td>36</td>
<td>46</td>
<td>35</td>
</tr>
<tr>
<td>% increase of the mean systolic BP before exercise</td>
<td>154 (23)</td>
<td>166 (24)</td>
<td>167 (30)</td>
</tr>
<tr>
<td>$\text{VO}_2\text{max} (\text{ml/min/kg})^||$</td>
<td>14 (4.6)</td>
<td>13.6 (3.5)</td>
<td>10.1 (4.2)</td>
</tr>
</tbody>
</table>

*Eight participants were not able to perform the test.

†Significant difference in distance walked between controls and NYHA III ($p < .02$) and between NYHA II and III ($p < .02$).

‡Significantly different from the values before exercise in all groups ($p < .001$).

§Significantly different from the values before exercise for controls ($p < .009$); for NYHA II patients ($p < .001$) and for NYHA III patients ($p = .028$).

||Significantly lower symptomatic $\text{VO}_2\text{max}$ in NYHA class III than in NYHA class II ($p = .032$).

To compare 6 MW and the treadmill, the distances in both tests are used. The distance walked in the 6 MW correlates well with the distance walked in the treadmill test ($r = .688$; $p < .001$) (Figure 3). Nevertheless, compared to the 6 MW, 6 patients (17%) walked only very short distances in the treadmill test. Of the 29 patients who performed both the 6 MW and the treadmill test, 21 walked longer distances in the 6 MW. On average, the distance in the treadmill test was 27% shorter ($p = .02$). There is no significant difference in systolic BP at rest or at peak exercise in both exercise tests.

**DISCUSSION**

The estimation of the severity of CHF by means of the NYHA classification implies that the severity is related to the exercise capacity (18). This classification, however, only uses the subjective judgment of the patient about his residual exercise capacity. A simple exercise test could give a more objective estimation of this capacity. Lipkin et al. (4) has proposed that younger patients use the 6 MW as an inexpensive test, which takes little time to perform and is technically simple. It is a safe (19) and well tolerated test, for which one can easily motivate an elderly patient. The test is more related to their daily activities than the widely used treadmill and bicycle tests (20). Therefore, it seems likely that it can give a good prediction of the exercise capacity of elderly subjects.

Our results show that the 6 MW is sensitive in discriminating a severe physical incapacity, due to CHF, subjectively scored as class NYHA III heart failure. The 6 MW was not able to make a clear difference between an untrained control person and a patient with mild CHF (NYHA II). This distinction, however, seems less important for the activities of daily living of the elderly. The test probably is also useful to follow an elderly patient in time or to evaluate him on new medication or physical training (12, 21-22). In younger patients with left ventricular dysfunction, the test also independently predicts morbidity and mortality (19). To our knowledge, this has not been documented in elderly patients.

We found the treadmill to be insufficient for testing elderly patients because of the high drop-out rate. As also reported by others, all patients preferred the 6 MW (20). Almost one fourth of the subjects had problems adapting to the treadmill and were unable to perform this test. The others had a higher resting heart rate before the treadmill test than before the 6 MW, probably indicating fear of the procedure. Six patients walked only very short distances on the treadmill, not in proportion to their performance on level ground in the 6 MW. Nevertheless, the distances obtained in both
tests showed a reasonably good correlation. Most of the patients performing on the treadmill continued their effort until exhaustion or dyspnea. This is proved by the important increase in heart rate. The 6 MW resulted in a comparable increase in heart rate, indicating that the features of the test (duration of 6 minutes; instruction to walk as far as possible) do allow an evaluation of the exercise capacity.

In accordance with the existing literature, the distances in the 6 MW were not related to resting left ejection fraction or to echocardiographic determinants (23-25). A discrimination on the basis of the VO2 measurements seems difficult to realize in this elderly population. It is known that VO2max decreases with aging. The figure of 14 ml/kg/min, obtained for the control patients, corresponds with the values described in the literature (26). We found only a slightly lower VO2max for NYHA class III patients. Elders probably become symptomatic before they realize their maximal O2 consumption (27). This is due to the decreased muscle mass, to the pulmonary changes that increase the sensing of dyspnea, and to increased peripheral vascular resistance (28-32). Therefore, the VO2max does not give an optimum impression of the limitations in exercise performance of the elderly patients with symptomatic CHF. For the same reasons, we think that in symptom-limited tests such as the 6 MW or treadmill, elderly persons sense earlier the symptoms of fatigue and dyspnea. This narrows the difference between controls and mildly handicapped CHF patients.

The BSG score seems to be a valuable addition to the widely used NYHA classification (21). This scoring system takes more parameters into account than the more subjective NYHA classification. Both scoring systems are reasonably well correlated. However, a considerable spreading with overlap of BSG score and NYHA classes II and III was observed. No patient scoring less than 8 on the BSG score or less than 3 in the NYHA classification walked less than 200 meters. All patients walking less than 200 m in the 6 MW had a BSG score of 8 at least, or were classified as NYHA III. Some patients walking more than 200 meters also had these high BSG scores. One patient, scoring 11 on the BSG score and NYHA III, was able to walk 345 m. This distance corresponds to the mean distance obtained in the controls and the NYHA class II group. For this patient, both NYHA and BSG scores can be considered as exaggerated. This patient illustrates well that the subjective impression of dyspnea does not always correspond to objective measurement. In conclusion, we think that in a clinical setting a treadmill test is less practical than the 6 MW. Also, because of the high percentage of ineligible patients, the treadmill test seems less useful than the 6 MW in determining the degree of heart failure in elderly people (33). The 6 MW can give a valuable appreciation of the residual exercise capacity in patients attained by CHF. It makes an interesting differentiation between serious and mild CHF. It also seems possible to judge vague symptoms in a more objective way. In combination with the BSG score, we possess a more objective standard for the evaluation and follow-up of CHF. It also allows us to predict better which elders are in danger of losing their autonomy for the activities of daily living. We are convinced that the 6 MW is a valuable asset in the objective evaluation of CHF in the elderly population.

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REFERENCES


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