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Which Exercise Test Should Be Used for Patients With Symptomatic COPD?

O ver the past decade, our understanding of exercise pathophysiology in patients with chronic airflow obstruction has expanded rapidly. Several articles, including one in this issue of CHEST by Turner et al (see page 765), have explored the responses to various testing protocols. I will argue that the 6-min walk test (6MWT) is the best one to use at a single point in time to assess a patient with symptomatic airflow limitation. It is also a good test to repeat to document declining exercise tolerance, and an adequate test to document improvement in function. Treadmill testing at constant workload is more sensitive for the latter purpose.1 Treadmill testing is also better if more advanced monitoring such as continuous electrocardiography or expired gas analysis is required during exercise. Cycle ergometry is less desirable since it has been shown to have important respiratory differences when compared with walking in this group, and is less closely related to the patient’s usual activities.2

Why should exercise testing be done in patients with COPD? The main reason is that it allows objective assessment of the effect of the disease on the patient’s ability to function. Such information may be helpful in deciding how aggressively to treat underlying airflow obstruction as well as in determining the need for supplemental oxygen, pulmonary rehabilitation, and surgical therapy (lung volume reduction and transplantation). Also, functional capability is an independent predictor of various outcomes in this group. Both mortality3,4 and postoperative complications5,6 are inversely related to this important variable. Unfortunately, spirometric parameters are poorly predictive of exercise ability,7 such that one patient may be in a wheelchair and another living independently with the same reduction in FEV1. Functional capability is often deter-
mined by patient history, but exercise testing provides a more objective assessment.

The advantages of the 6MWT are that it is involves a simple and safe activity that is familiar to the patient. It requires nothing other than a 100-foot hallway, and it has become better standardized with normal reference equations and American Thoracic Society guidelines aimed at reducing some of the sources of variability. This test represents an improvement over the older 12-min version that was more difficult for patients to complete.

For most normal subjects, especially younger ones, the 6MWT is a submaximal exercise test since running is not allowed. However, for patients with severe COPD, it produces stress similar to a maximal test. In the present study, the 6MWT was compared to two other incremental maximal tests, one walking and one on the bicycle, in a group of patients with COPD and severe airflow obstruction (mean FEV₁ 28.9% of predicted). They reached similar heart rates and dyspnea scores in all three tests, and both walking test results demonstrated greater arterial oxygen desaturation than did the cycle ergometry test. The patients’ Borg scores rose linearly throughout the time they performed the 6MWT.

One would expect a normal subject to have minimal dyspnea with brisk walking, and one might expect a patient with COPD to have his or her dyspnea level rise to some point and then reach a plateau, but this did not happen. A study by O’Donnell et al.⁹ may explain this finding. Patients with severe COPD (mean FEV₁, 40% of predicted) were exercised on a treadmill at a constant submaximal workload, a situation similar though not exactly like the 6MWT (where patients may vary their speed). The investigators documented a progressive decline in inspiratory capacity (presumably due to hyperinflation) and a linear rise in Borg score. The progressively worsening respiratory mechanical stress eventually caused the patients to stop with an average Borg score of approximately 5 (“severe dyspnea”). The mechanism of the worsening dyspnea despite the relatively constant workload in the present study during the 6MWT is likely to be the same.

The main disadvantage of the 6MWT is that it only measures global function, without specific information regarding the cause of the limitation. Also, patients with minimal or mild limitation from their disease cannot fully demonstrate their exercise ability since walking on a level surface is the only activity allowed. Another disadvantage is that a patient can only show improvement in ability in subsequent testing by walking faster. Some patients have difficulty walking faster due to such factors as stride length, but can walk up a steeper grade with improvement in their overall condition.¹⁰ A treadmill allows this option whereas floor walking tests do not. Also, both rehabilitation and medications are more likely to make patients with COPD able to walk longer at the same speed, rather than faster.¹⁹ Timed walk tests, by definition, cannot be used to demonstrate this, but a treadmill set at a constant speed can. Overall, the treadmill is more versatile and can be used with or without expired gas analysis, but is more expensive and requires space and expertise.

The incremental shuttle walking test (ISWT) is intended to be a maximal exercise evaluation but has little advantage in this group of patients. It has all the disadvantages of the 6MWT in that patients can only demonstrate improvement by walking faster. Also, it is more complicated and therefore likely to have greater variability in the results. Since the patient starts out at slower speeds, dyspnea scores and heart rate rise more gradually than the 6MWT as noted in the present study. The slower rise in heart rate may be an advantage for a patient who has coronary disease; however, one could argue that if this is likely, the patient should be exercised on a treadmill with ECG monitoring. A newer version of this test referred to as the endurance shuttle walking test can be used to show increases in walking time.¹¹ It requires that the patient first do an ISWT, and then subsequent tests measure the distance walked at 85% of the maximum speed along the same 10-m shuttle course. This may serve as an alternative to constant rate submaximal treadmill testing as a sensitive means of following improvement in exercise function, but further research is needed.

Finally, stationary bicycle exercise should be considered. It has the advantage of very precise quantitation of external work, which can facilitate calculation of certain parameters during formal cardiopulmonary exercise testing. Also, the patient is in a more fixed position than when on a treadmill, so that becoming disconnected from gas measurement equipment is less of a problem. The main disadvantage is that cycling has different physiologic effects compared with walking in patients with severe COPD. In a study by Palange et al.,¹² nine patients with severe COPD underwent ISWT and bicycle ergometry. Portable equipment allowed expired gas analysis via face mask with both tests. At peak exercise, heart rate, oxygen consumption, expired ventilation, dyspnea, and leg effort scores were similar with both types of exertion; however, PaO₂ was substantially higher with cycling (65.0 torr vs 57.7 torr). Also, carbon dioxide production was about 31% higher with cycling, and the blood lactate level was higher and the peak minute ventilation/VCO₂ and physiologic dead space ventilation were lower.
than with walking. The authors speculated that differences in body posture, functional residual capacity, and/or hemodynamics probably caused these findings. The ability to fix the arm position with the handlebars may improve accessory muscle use in a manner that improves respiratory efficiency on the bicycle. The authors concluded that “cycling may not reflect precisely their ventilatory and metabolic requirements for daily activities such as walking.”

The current study and another recent investigation confirm that arterial desaturation is more likely to occur with the 6MWT than with maximal cycling. Whether walking or cycling more correctly demonstrates the physiologic abnormalities with exercise in severe COPD really does not matter. Most patients with COPD do not ride a bicycle, but they nearly all walk.

In summary, Turner et al have added to our understanding of the evaluation of dyspneic COPD patients by comparing the 6MWT, ISWT, and cycle ergometry tests in a group with substantial airflow obstruction. In this population, all three act as maximal tests. The walking tests are more likely to identify oxygen desaturation, and the 6MWT is the easiest to perform. For many situations, it is an adequate test, although treadmill testing may be necessary for specific applications such as those mentioned above.

James E. Johnson, MD, FCCP
Birmingham, AL

Dr. Johnson is Associate Professor of Medicine, Physiology and Biophysics, Division of Pulmonary, Allergy and Critical Care Medicine, University of Alabama at Birmingham. Dr. Johnson has received honoraria for speaking for Boehringer Ingeheim and Glaxo Pharmaceutical Companies. Reproduction of this article is prohibited without written permission from the American College of Chest Physicians (e-mail: permissions@chestnet.org).

Correspondence to: James E. Johnson, MD, FCCP, BDB 398, 1808 Seventh Ave South, Birmingham, AL 35294-0012; e-mail: jej@uab.edu

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Treatment of Severe Acute Respiratory Syndrome

Severe acute respiratory syndrome (SARS) is a newly emerged infectious disease that has posed an enormous threat to international health. During the global outbreak in 2003, the most severely affected countries were China (ie, mainland China, Hong Kong, and Taiwan), Vietnam, Canada, and Singapore. On July 5, 2003, the World Health Organization announced that the last known chain of human-to-human transmission of SARS had been broken in Taiwan.5 This brought an end to the initial outbreak of SARS that had begun in mid-November 2002 in southern China and had spread internationally in late February 2003. Genetic analysis showed that the SARS coronavirus (CoV) isolates from Guangzhou shared the same origin with those in other countries, with a phylogenetic pathway that matched the spread of SARS to other parts of the world.6 As of July 31, 2003, 8,098 probable cases had been reported in 29 countries and regions with a death toll of 774 (9.6%).

Due to the limited knowledge about this newly emerged disease, the treatment of SARS was empiric during the outbreak in 2003. Apart from supportive care, the appropriate treatment for SARS is unknown at present. No prospective, randomized, placebo-controlled study of any intervention has been reported. Respiratory failure is the major complication of SARS. Hypoxemia develops in almost half of affected adults, and 20 to 36% of adults may require...