SIX-MINUTE WALK TESTING DURING HOSPITALIZATION FOR CF PULMONARY EXACERBATION

Lisa M. Bibler, DPT[1]; Michelle T. Stinson, PT[1]; Alex H. Gifford, MD[2]

1. Department of Rehabilitation Medicine, Dartmouth-Hitchcock Medical Center, Lebanon, NH USA
2. Section of Pulmonary and Critical Care Medicine, Dartmouth-Hitchcock Medical Center, Lebanon, NH USA

Background

Level of aerobic fitness, as reflected by the rate of oxygen consumption at maximal exercise ($VO2_{max}$), is independently predictive of prognosis in CF (1). Two studies that compared healthy age-matched controls with normal spirometry to CF patients with moderate airflow obstruction showed significant exercise limitation in CF (2, 3). Also demonstrated in these investigations was a significant correlation between $VO2_{max}$ and percent-predicted FEV_1. Mindful that heart rate obtained at anaerobic threshold (AT) during cardiopulmonary exercise testing is helpful in prescribing exercise to patients with lung disease (4), Gruet *et al*. (5) discovered that heart rate at the end of 6-minute walk testing (6-MWT) correlated significantly with heart rate at AT in adult CF patients. In a cohort of adult patients who were admitted for treatment of CF pulmonary exacerbation, we sought to identify features associated with heart rate at the end of 6-MWT (HR_{6peak}) and 6-minute walk distance (6-MWD) with a goal of customizing the intensity of rehabilitation medicine services during the hospital stay.

1) Nixon PA *et al*. *New Engl J Med* 1992; 327: 1785-8.
2) Shah AR *et al*. *Am J Respir Crit Care Med* 1998; 157: 1145-50.
3) Moorcroft AJ *et al*. *Eur Respir J* 2005; 25: 1050-6.
4) Vallet G *et al*. *Eur Respir J* 1997; 10: 114-22.
5) Gruet M *et al*. *Arch Phys Med Rehabil* 2010; 91: 602-7.

Patient Characteristics

Number of patients (*N*)	28
Age (years)	28.4 ± 13.9
Gender (M/F)	17/11
Hospital Length of Stay (days)	9.7 ± 3.7
Time to Spirometry* (days)	7.0 ± 2.7
Time to 6-MWT* (days)	6.7 ± 2.6
BMI (kg/m^2)	21.5 ± 6.9
FEV_1 (% predicted)	51.5 ± 24.3
dF508 homozygote (%)	75

Table 1. Clinical features of 28 adult CF patients who underwent 6-minute walk testing (6-MWT) during hospitalization for pulmonary exacerbation. Data are presented as means ± SD unless otherwise noted. * = from day of admission.

6-MWT - Measurements

	Units
Resting heart rate (HR_{rest})	BPM
Heart rate at the end of 6-MWT (HR_{6peak})	BPM
Ratings of perceived exertion (RPE)	Borg scale
Oxyhemoglobin saturation (SpO_2)	%
Recovery time	Minutes
6-minute walk distance (6-MWD)	Meters

Table 2. Parameters assessed during 6-MWT of hospitalized adult CF patients

HR Response and 6-MWD

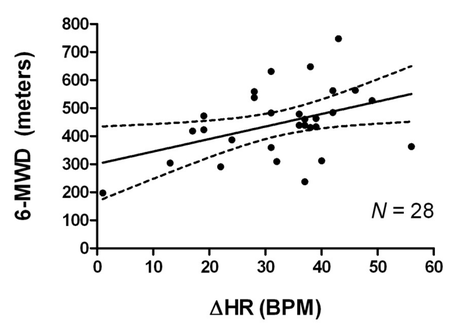

Figure 1. 6-MWD as a function of activity-related change in heart rate (ΔHR) during 6-MWT. The correlation coefficient (*R*) for the best-fit regression line is 0.42 (P = 0.02). Dotted lines denote the 95% CI for the best-fit regression line.

6-MWD and HR Reserve

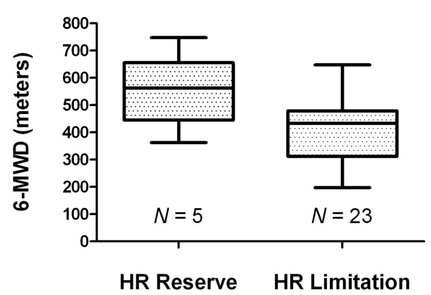

Figure 2. Patients with HR reserve walk farther during 6-MWT. HR reserve = $HR_{6peak} - HR_{rest} \geq 42$ BPM. HR limitation = $HR_{6peak} - HR_{rest} < 42$ BPM. Mean 6-MWD for patients with HR reserve was 552.7 ± 136.9 meters vs. 422.5 ± 113.9 meters for those with HR limitation (P = 0.03 by unpaired t-test).

Resting Tachycardia and FEV1%

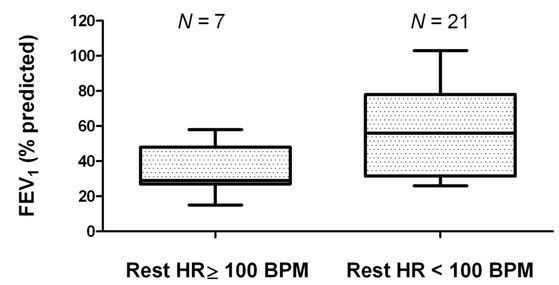

Figure 3. Patients with $HR_{rest} \geq 100$ BPM had worse lung function than those without ($HR_{rest} < 100$ BPM). Mean percent-predicted FEV_1 was 34.6 ± 14.4 in patients with resting tachycardia vs. 57.5 ± 25.0 in those with slower heart rates after a comparable number of days in the hospital (P = 0.03 by unpaired t-test).

Age and 6-MWT Recovery Time

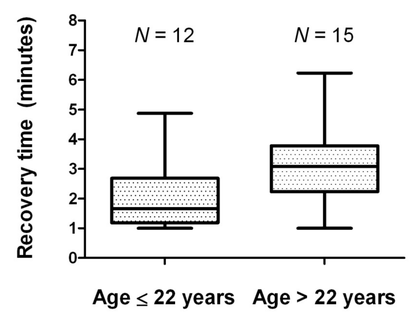

Figure 4. Patients > 22 years old took longer to recover after 6-MWT than younger patients. Recovery time was defined as the time necessary for heart rate to return to HR_{rest} and was available for 27 patients. The mean difference in recovery time was 1.1 ± 0.5 minutes (P = 0.03 by unpaired t-test).

Conclusions

From 28 adult CF patients who underwent 6-MWT during hospitalization, we made the following salient observations:

1) ΔHR during 6-MWT was directly related to 6-MWD.

2) Patients with resting tachycardia had shorter 6-MWD.

3) $HR_{rest} \geq 100$ BPM was associated with lower FEV_1%.

4) Patients > 22 years old had longer recovery times.