Clinical 6 Minute Walk Test use in patients with Barth Syndrome

Brittany DeCroes, PT, DPT
Kennedy Krieger Institute, Baltimore, MD

Background/Objectives/Issue/Case:

Barth Syndrome is an x-linked genetic disorder of lipid metabolism primarily affecting males cause by a mutation in tafazzin gene (TAZ, G4.5). The cardinal characteristics of Barth Syndrome include: cardiomyopathy, neutropenia, muscle hypoplasia and weakness/exercise intolerance, growth delay, 3 methylglutaconic aciduria and cardiolipin deficiency. Previous research done in this population has concluded that exercise intolerance in Barth Syndrome appears to share similar characteristics with mitochondrial myopathies and adult heart failure (Spencer et al 2011).

The 6 Minute Walk Test (6 MWT) has been used in a variety of pediatric and adult populations to assess functional exercise capacity. The 6 MWT has been administered to a variety of patient populations including: Muscular Dystrophy, Spina Bifida, Juvenile Idiopathic Arthritis, Hemophilia, patients with left ventricular systolic dysfunction, and patients post stroke. The 6 MWT is a better indicator of performance during activities of daily living in comparison to the cardiopulmonary exercise stress test secondary to it not requiring one to exercise to the point of exhaustion.

The goal of this study was to compare 6 MWT performance of pediatric and adult patients with Barth Syndrome to that of values of healthy children and adults in the literature. The hypothesis was that children and adults with Barth syndrome would demonstrate decreased distance on the 6 MWT in comparison to reported values for healthy subjects in the literature.

Methods/Project:

Patients participating the Kennedy Krieger Institute Multidisciplinary Barth Syndrome Clinic were administered a clinical 6 MWT as part of a physical therapy evaluation from December 2012 to December 2013. Measurements taken pre and post 6 MWT were the heart rate, oxygen saturation, dyspnea and fatigue measured using the Borg scale (for patients over the age of 13). Heart rate and oxygen saturation were obtained using a pulse oximeter. The Pediatric Rating of Perceived Exertion Scale was used pre and post 6 MWT in patients under the age of 13. Additional information on height was obtained from the nursing triage data sheet. Participants included 4 adults aged from 23-30 years old (one completed the 6 MWT on 3 separate occasions) and 2 pediatric patients, ages 8 and 13. Correlations and trends were analyzed utilizing Microsoft Excel 2010. Average distance walked in 6 minutes was compared with predicted values (calculated from published reference data) using a single sample t-test.

Results:

Patient Number	Age (in years)	Height (cm)	Distance walked (meters)	Predicted 6 MWT Distance (meters) (Jenkins 2009)	6 MWT Actual to Predicted (%)
1	23.75	186	327.96	922.97	35.53
2	24.42	179	399.90	911.93	43.85
3	26.67	176.5	504.14	896.51	56.23
4	27.17	177	432.51	894.17	48.37
5	27.67	175.3	504.14	889.56	56.67
6	30	185	307.54	886.25	34.70

Table 1. Age, Height, Distance Walked and Predicted 6 MT Distance (based on equation in Jenkins et al 2009), 6 MWT Actual Distance Walked Compared to Predicted % for Adult patients seen in Multidisciplinary Barth Syndrome Clinic at Kennedy Krieger Institute from December 2012 to December 2013.

Patient Number	Age (in years)	Height (cm)	6 MWT distance (m)	Dyspnea Change Post-Pre (Borg)	Fatigue Change Post-Pre (Borg)	HR Change Post-Pre (bpm)
1	23.75	186	327.96	1	1	31
2	24.42	179	399.90	3	5	39
3	26.67	176.5	504.14	5	5	39
4	27.17	177	432.51	3	2	41
5	27.67	175.3	504.14	2.5	2.5	29
6	30	185	307.54	1.5	1	21

Table 2. Age (years), Height (in centimeters), 6 MWT Distance (meters), Dyspnea Change Post 6 MWT – Pre 6 MWT utilizing the Borg Scale, Fatigue Change Post 6 MWT – Pre 6 MWT utilizing the Borg Scale, Heart Rate Change: Post 6MWT – Pre 6MWT in beats per minute.

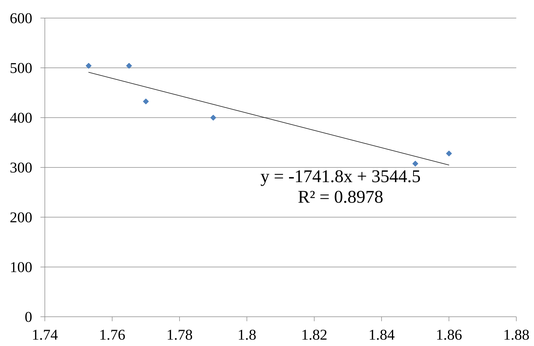

Figure 1. 6 MWT Distance (m) vs. Height (m) for Adult Barth Syndrome patients.

Patient Number	Age (in years)	Height (cm)	6 Minute Walk Test Distance (meters)	Predicted 6 MWT Distance (meters) (Geiger 2007)	6 MWT Actual to Predicted (%)	HR Change Post-Pre (bpm)
7	13.92	139	472.74	671.22	70.43	79
8	8.83	117	415.75	596.97	69.64	38

Table 3. Age, Height, Distance Walked and Predicted 6 MWT Distance (based on equation by Geiger et al 2007), 6 MWT Actual Distance Walked Compared to Predicted %, HRChange: Post 6 MWT- Pre 6 MWT for pediatric patients seen in Multidisciplinary Barth Syndrome Clinic at Kennedy Krieger Institute from December 2012 to December 2013.

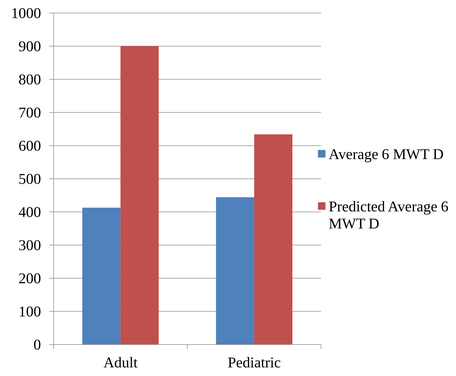

Figure 2. Average 6 Minute Walk Test Distance (6 MWT D) in m vs. Average Predicted 6 MWT D in adult and pediatric patients.

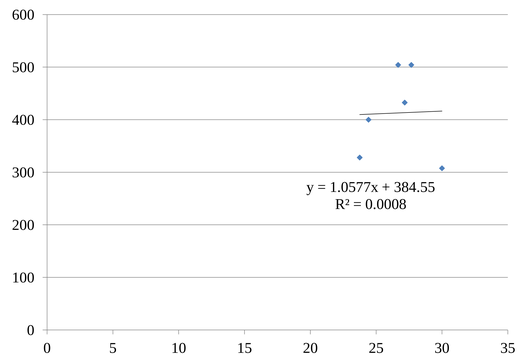

Figure 3. 6 Minute Walk Test Distance (m) vs. Age (years) for Adult Barth Syndrome patients.

Results:

The mean distance walked by adult male subjects aged 23 to 30 years with Barth Syndrome is 412.70 meters (m) with a standard deviation of 84.28 m. The mean distance walked by pediatric patients with Barth Syndrome was 444.25 m with a standard deviation of 40.30 m. There was a strong negative correlation between height and 6 MWT distance in adults. Height explained 89.78% of the variance in 6 MWT distance in adults (Figure 1). The adults with Barth Syndrome on average achieved 45.89% of predicted walking distance. The pediatric patients with Barth Syndrome achieved on average 70.04% of predicted walking distance (Figure 2). The adult and pediatric distances walked on 6 MWT were significantly less than predicted values (p values: adult: 1.12E-05, pediatric: 0.03). There was not a correlation between age and 6 minute walk test distance in adults (Figure 3).
.

The average heart rate increase for adult males with Barth Syndrome following the 6 minute walk test was 33.33 bpm with a standard deviation of 7.74 bpm. The average dyspnea change was 2.67 with a standard deviation of 1.40 utilizing the Borg Scale. The average fatigue change was 2.75 with a standard deviation of 1.84 utilizing the Borg Scale.

The average heart rate change for pediatric patients was 58.5 bpm with a standard deviation of 28.99 bpm. Unable to compare dyspnea and fatigue for pediatric patients secondary to being obtained with different scales (Pediatric Rating of Perceived Exertion Scale vs. Borg scale).

Conclusions/Lessons Learned:

Walking distances in children and adults with Barth syndrome are significantly reduced compared with healthy references. The 6 MWT is safe and easy to perform in patients with Barth Syndrome. Clinicians should utilize the 6 MWT with pediatric and adult patients with Barth Syndrome to establish normative values for this population as well as use it in the future to evaluate progress following intervention to determine its impact on function.

References:

American Thoracic Society. ATS Statement: Guidelines for six-minute walk test. Am J Respir Crit Care Med 2002;166:111-17.

Geiger R, Strasak A, Treml B, Gasser K, Kleinsasser A, Fischer V, Geiger H, Loeckinger A, Stein JI. Six-minute walk test in children and adolescents. J Pediatr 2007;150:395-9.

Jenkins S, DipPhys G, Cecins N, Camarri B, Williams C, Thompson P, Eastwood P. Regression equations to predict 6-minute walk distance in middle-aged and elderly adults. Physiotherapy Theory and Practice 2009;25(7):516–22.

Spencer CT, Byrne BJ, Bryant RM, Margossian R, Maisenbacher M, Breitenger P, Benni PB, Redfearn S, Marcus E and Cade T. Am J Physiol Heart Circ Physiol 2011:301:H2122-H2129.