Validation of the MST-25: an extension of the modified shuttle test (MST)

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Introduction: The Modified Shuttle Test (MST) is an externally paced, incremental, field exercise test with 15 levels. It has been shown to be a reliable, repeatable and sensitive measure of exercise capacity in adults with cystic fibrosis (CF). However, 6% of patients exceed the 15th level of the test. Furthermore, 31% of age-matched healthy adults exceeded the 15th level. This limits the utility of the MST as a measure of exercise capacity in studies comparing participants with CF to healthy control participants. The purpose of this study was to assess the reliability of the MST with 25 levels (MST-25).

Methods: The MST was extended by 10 levels, with the number of shuttles increased by one at each additional level. 15 participants (10 healthy, 5 CF) performed the MST-25 on two occasions within one week. All participants were clinically stable (<10% variation in FEV1 from the best during the previous 6 months). All participants wore the SenseWear Pro3 Armband (BodyMedia, USA) – a physical activity monitor that integrates accelerometry and physiological sensors to estimate energy expenditure. Total step count, Borg Dyspnoea Score and heart rate were recorded at the end of the test.

Results: There was a significant and strong correlation between the two MST-25 test days for distance completed (Pearson’s r = 0.99), SpO2 at peak (r = 0.99), energy expenditure estimated by the SenseWear Pro3 Armband (r = 0.97), and total step count (r = 0.97). Correlations were less strong for dyspnoea (r = 0.76) and heart rate (r = 0.78) at peak exercise.

Discussion: The MST-25 shows good test-retest reliability and can be used for patients and healthy controls whose peak exceeds the MST. We are now investigating the sensitivity of the MST-25 to clinical change.

Desaturation on 3-minute step test is associated with impaired outcomes at 12 months in adults with cystic fibrosis

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Objective: To investigate the relationship between desaturation on the three-minute step test (3MST) and clinical outcomes at 12 months (change in % predicted FEV1 and inpatient hospital days) in adults with cystic fibrosis (CF). Method: The 3MST was conducted following a standardised protocol using a 15 cm high step, external pacing at 50 steps/minute and continuous monitoring of SpO2, heart rate and perceived exertion on the Borg scale. Results: Desaturation on the 3MST was associated with impaired outcomes at 12 months in adults with CF. Conclusion: Performance on the 3MST may be associated with long-term pulmonary deterioration and increased hospital admission days. Larger samples are required to confirm the prognostic value of the 3MST in adults with CF.

Mathematical modelling of oxygen uptake during recovery from exercise

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Objective: To develop a mathematical model of oxygen uptake (Vo2peak) during recovery following CPX to predict exercise capacity in children with cystic fibrosis (CF) and a measure of disease severity. Methods: A mono-exponential model including a delay term, with the formula: Vo2(t) = A[1−exp{−(t−TD)/T}]. Results: During and for 10 min after CPXT. Following CPXT the fast component of VO2 recovery. Disease severity in the children with CF was quantified by the Shwachman score. Conclusion: The model can predict VO2 peak at a given time point and can be used to assess the impact of disease severity and disease on VO2 recovery.

Reference values for maximal aerobic exercise capacity in children with cystic fibrosis

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Objective: To determine reference values for VO2max in healthy children as a function of age, sex, and body mass index (BMI) using whole body modeling. Method: Data were acquired from a database (1998–2008). Results: VO2max was measured during CPET. Anthropometric variables are expressed as weight and height and lung function as the forced expiratory volume in 1 second (FEV1). Data were analyzed using the GAMLSS method. Conclusion: Reference values allow clinicians to compare exercise capacity of individual patients with that of their peers with CF. This could improve treatment decisions and individualize therapy.