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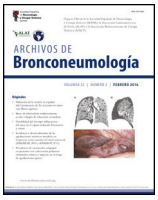

Editorial

Prediction of Maximal Oxygen Uptake From Submaximal Exercise Testing in Chronic Respiratory Patients. New Perspectives

Predicción del consumo máximo de oxígeno mediante pruebas de ejercicio submáximo en pacientes con patología respiratoria crónica

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One of the most effective non-pharmacological treatments for COPD is a programme of pulmonary rehabilitation.[1] Both the American Thoracic Society and European Respiratory Society[2,3] agree that exercise is the cornerstone of such programmes, resulting in reduced dyspnoea, increased exercise tolerance and improved quality of life. One of the challenges that practitioners have faced in prescribing exercise is to decide the intensity for a personalised intensity.

The individualisation of exercise prescription should be based upon prior physiological assessment.[4] For COPD patients the most appropriate approach is to measure cardiopulmonary capacity through an exercise test. Exercise tests require the integration of ventilatory, cardiovascular and skeletal muscle systems to supply oxygen to the respiring mitochondria. A limitation within these systems will result in impaired exercise tolerance. However, both the cardiovascular system and skeletal muscle adapt to regular exercise provided it is prescribed at appropriate exercise intensity.

Maximum oxygen uptake (VO_2 max.), a measure that reflects the ability of skeletal muscle mitochondria use the oxygen supplied by the ventilatory and cardiovascular systems, is assessed by an incremental exercise test.[5] The results of this test can be used to prescribe exercise at an individualised exercise intensity. Furthermore, VO_2 max scores have been used to classify an individual's aerobic fitness[6] and it is also inversely related to post-operative complications.[7]

A valid VO_2 max measurement however requires those undertaking it to perform exercise to exhaustion; this may not be appropriate for those with clinical conditions such as COPD. To avoid these risks, alternative sub-maximal tests are employed, the American Thoracic Society advocate cycle ergometer tests, while others prefer the 6 min walk test.[8] Sub-maximal tests require VO_2 max to be predicted either from heart rate recorded during the test or the level of exercise e.g. power output, achieved within the test. In both instances, there is usually high predictive errors,[9] while cycle tests suffer from the added limitation of being a non-specific movement pattern. The consequences of inaccurate prediction include inappropriate individualised training intensities, the misclassification of either fitness or post-operative risk. While not life threatening, these consequences can affect patient outcomes.

In a recent work from our group, a 6-min sub-maximal run test was used to accurately predict VO_2 max.[10] We proposed a new and innovative methodology to estimate the VO_2 max that could easily be adapted for any physiological parameter or sport performance indicator. The test was a low intensity, incremental treadmill test coupled with, with a novel statistical technique called functional data analysis (FDA). Its main advantage compared to other widely used alternative tests, was the low predictive error of the VO_2 max score. In our work, the accuracy achieved through using FDA resulted in a reduction of measurement error by more than 25% compared other traditional approaches. We attained a measurement error (RMSE) of 2.8 mL min^{-1} kg^{-1}, a value very close to that achieved in maximal, directly measured tests. Our method is not without its limitations, requiring the measurement of VO_2 during the test and a value for maximum heart rate, although most clinical units can now record this data. These results were obtained using a large ($N = 299$), heterogeneous sample of sportsmen and women (VO_2 max (range): 30.2–80.1 mL min^{-1} kg^{-1}, mass (range): 35.2–132.0 kg). The validity of this test in patients with chronic clinical conditions e.g. COPD, must be established but further refinements could include the use of a personalised intensity to terminate the test, e.g. ventilatory threshold. An improved accuracy in predicting VO_2 max increases the likelihood of individualised exercise programmes being even more effective in treating patients with chronic diseases.

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