Peak oxygen uptake and exercise capacity: a reliable predictor of quality of life?

With great interest we read the manuscript published by Gratz et al. addressing the important issue of quality-of-life (QoL) and its possible correlation to exercise capacity in patients with congenital heart disease (CHD). The majority of surprisingly high QoL scores were not correlated to exercise capacity as quantified by peak oxygen uptake (peakVO₂).

However, several questions have to be addressed concerning the manuscript. Gratz et al. showed unreliably high peakVO₂ results with single values of more than 70 mL/kg/min. Applying our own recently published reference equations on these values would result in a peakVO₂ of 170% as personally predicted (for a male subject of 25 years, 180 cm, 70 kg). Even the mean peakVO₂ of their population partly exceeds the age, sex, and body size-adjusted fifth percentile for subjects of the above mentioned demographics. In addition, the cited reference values by Cooper et al. are not corrected for body weight; calculating a reference value for a dummy subject as described above results in about 3400, very likely not mL/kg/min. Furthermore, the applied reference equations provide unusually high reference values for peakVO₂ when compared with ours and others.3–4

Besides methodological inconsistencies, it remains disputable to what extent peakVO₂ contains reliable potencies to quantify QoL in a severely diseased population. QoL in patients with cardiac pathologies is well reflected by measures other than peak exercise values. For patients with congestive heart failure as well as pulmonary hypertension parameters of ventilatory inefficiency have been shown as reliable predictors of dyspnoea,5–7 a leading cause of exercise limitation in patients with CHD as well. Our own data in 25 adults with congenital cyanotic heart disease have shown that simple scores of the ability to accomplish daily life as well as dyspnoea are best reflected by measures of ventilatory inefficiency.9 For the slope of the regression of ventilation to carbon dioxide output (VE vs. VCO₂ slope), these differences were: ABILITY II 43 ± 14; III 56 ± 25; IV 87 ± 37 (P < 0.001). Oxygen uptake at peak exercise and anaerobic threshold were less significantly correlated to dyspnoea and daily life symptoms.

PeakVO₂, as assessed within a symptom-limited ramp-wise incremental exercise test, is probably hampered because of its limited reflection of capacity for daily activities. In severely diseased subjects it has been shown that peakVO₂ values are higher if assessed within a six-minute walk test in comparison with incremental tests.9 This surprising difference possibly explains the limited value of the applied test design to correlate peakVO₂ to QoL. Patients with severe cardiac abnormalities do very likely avoid exercising up to the extremes resulting in diminished peakVO₂ but irrelevant for the daily life.

Gratz and colleagues do have an excellent material in their hand to further clarify which functional correlates do best reflect the underlying pathophysiology influencing QoL in this specific patient population. Focusing on sub-maximal parameters as well as values describing gas exchange may provide such explanations. The missing link of QoL to peakVO₂ is, however, not surprising.

References

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Peak oxygen uptake and exercise capacity: a reliable predictor of quality of life?: reply

Gläser et al.1 were concerned in their Letters to the Editor in response to our article2 that...
our reference calculation for peakVO₂ might be incorrect. We agree that the original equation results in peakVO₂ in millilitre/minute; however, our transformation to millilitre/kilogram/minute is correct. Maybe we should remind that height must be provided in metres. For a sample reference subject (male 25 years; 1.8 m; 70 kg), a value of 43.6 mL/kg/min is calculated. This agrees fairly with Wassermann (41.4), and recently 43.6 mL/kg/min is calculated. This agrees also the results of our control group support the proper choice of reference values.

We totally agree that the single female patient with a peakVO₂ of 70.8 mL/kg/min (195% of predicted) is an exception in congenital cardiology. She was a 15-year-old endurance trained girl after surgical closure of an atrial septal defect with the age of 6 years. The same holds true for a 24-year-old man with a small ventricular septal defect and a mild pulmonic valve stenosis and regurgire, who reached 60.9 mL/kg/min (141% of predicted). They clearly show that patients can have an excellent outlook after repair or with minor defects.

A second concern in the letter of Gläsers was whether other variables of a cardiopulmonary exercise test could reflect quality of life more properly. We chose to compare peakVO₂ as the most reliable variable for cardiovascular fitness with quality of life, as the SF-36 contains 10 very stringent questions on physical limits in daily life summarized in the physical functioning scale. VO₂/VCO₂ slope as a marker of ventilatory inefficiency is an excellent addition to peakVO₂. It is related to symptoms (NYHA class) as well as to prognosis. However, the SF-36 is a generic instrument not asking for cardiopulmonary symptoms like dyspnoea. The correlation of the VO₂/VCO₂ slope to the SF-36 scales in our study were similar or even less strong than that of peakVO₂. Significant correlations could only be found to physical functioning (n = 422, r = −0.473, P = 6.5 x 10^−25), general health (n = 418, r = −0.336, P = 1.8 x 10^−12), and vitality (n = 419, r = −0.154, P = 0.002). Similar results were found with peak heart rate.

Finally, we do agree that submaximal exercise tests like the six-minute walk test reflect the daily needs of severely limited patients better than a symptom-limited (=maximal) exercise test. The predictive value of the six-minute walk test is best, when it is almost a maximal exercise test. However, in patients with ‘only’ minor or moderate limitations, the six-minute walk distance is highly influenced by many other parameters like motivation, leg length, or ability to turn quickly at the turning points. Only 8% of our patients did not reach 14 mL/kg/min. We assume that most of our patients, with the exception of the cyanotic group and some patients from the Fontan or atrial switch group would have reached 400 m or more in a six-minute walk. Then, to our experience, the test becomes less reliable and also less meaningful.

References

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