CORRESPONDENCE

Exercise Testing in Sports Medicine

by Prof. Dr. med. Herbert Löllgen and Prof. Dr. med. Dr. Sportwiss. Dieter Leyk in issue 24/2018

Validity of Exercise ECG

In their review article, the authors have presented the often underestimated importance especially of bicycle and treadmill ergometry beyond the exercise electrocardiogram (ECG) (1). A mention of the limited sensitivity of exercise ECG in diagnosing coronary heart disease would still have been desirable, because the pretest probability is low in athletes and most sports medical patients.

An important target criterion in exercise testing in sports medicine is the physical performance, measured as maximal oxygen intake ($\text{VO}_{2\text{max}}$), for example. In order to ensure the most accurate possible assessment, it is necessary to consider different criteria for volitional exhaustion such as maximal heart rate, maximal lactate concentration or maximal respiratory quotient. It is not clear why the authors included $\text{VO}_{2\text{max}}$ as a criterion for exhaustion, in addition to the criteria mentioned above (1). A low $\text{VO}_{2\text{max}}$ does not necessarily mean a low degree of exhaustion, but usually inadequate physical performance. When an exercise test is not exhaustive, the highest oxygen intake during exercise is known as $\text{VO}_2^{\text{peak}}$.

The authors assessed training recommendations on the basis of lactate thresholds as rather negative (1). This sounds apodictic especially since they cite mainly their own publications. In order to do justice to this complex problem, an adequate discussion of the international literature is required (2).

The authors make a daring statement by saying that blood pressure values of up to 300 mm Hg can be regarded as normal at very high intensities (1). Highly trained endurance athletes with high cardiac output can reach systolic blood pressure values during maximal exercise tests that clearly exceed the upper limit of 210 mm Hg (3) named in the ESC (European Society of Cardiology) guidelines (4). In any case, however, if extreme values near 300 mm Hg are reached, further diagnostic evaluation should be performed. Whether high blood pressure values in athletes are of prognostic relevance is something that cannot currently be evaluated.

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Degree of Physical Performance Capacity

The first sentence of the abstract (1) conforms to the traditional view in suggesting that exercise testing can be used to assess physical performance capacity. The singular is misleading: the term physical performance capacity is suitable for the purposes of systematization and distinction from other aspects of performances. Any real degree of physical performance is, however, based on a complex interaction of many performance-specific personality traits. Real professional or athletic performance can therefore not be measured by one single test, unless the special performance is tested directly or in a close-to-reality simulator—as has been the case for a long time for air pilots and other vehicle drivers. A firefighter very rarely has to cycle to the site of a fire, and his/her task-specific performance capacity can be assessed rather better by means of a test track than by using a bicycle-ergometer.

With an ergometer only the ergometric performance capacity under the actual testing conditions is assessed, and even tests done on a bicycle ergometer will yield different performance values depending on the type of ergometer. To postulate a general endurance performance capacity on the basis of such a test is far-fetched, because movement-technique and the muscle groups involved are very task-specific for each type of endurance sports—cf rowing and pedaling an ergometer, for instance.

Just one more comment for the occupational health physician: according to the stress-strain concept, exercise testing does not measure stress. What is being measured is the intensity of work or work/time (ergon = work).

Even though the article is a selective literature search, the problems described here could have been included in the “Overview and future perspective” section.

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Reference

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Exercise Testing in Sports Medicine

The authors underlined the importance of exercise testing by means of a detailed description of the current recommendations (1). The perhaps most important comment on exercise testing in practice is somewhat hidden in the legend of the table showing peak performance criteria: it is pointed out here that ergometric stress testing should not be terminated even when the peak performance criteria have been met. Unfortunately, in practice genuine peak performance to the point of exhaustion is often not

undertaken. This means that in the examination, the sensitivity for diagnosing pathological findings drops and the maximal performance capacity is not adequately assessed.

The recommendation of increasing work load by 40 watt increments is unusual and is based on older publications. This increment is not generally accepted, neither nationally nor internationally, neither in studies nor in practice. The recommendation is all the more surprising because several years ago, one of the authors of the present summary recommended as a co-author the now established incremental increases of 25 or 50 watts as the standard for the German Cardiac Society (2). These increments are also recommended for exercise testing in lung disease in the article also cited by the authors. Further international guidelines and studies cited by the authors do not recommend the 40 watt increment either. The authors' suggestion to create a nationwide fitness and health registry deserves unreserved support (1), but this can be realized only based on a generally accepted ergometry protocol.

Mundal et al., in a study conducted over 16 years, identified systolic blood pressure under 100 watt stress load as one of the most important prognostic factors for myocardial infarction and death. This value should be registered precisely and should be included in assessing cardiovascular risk. The cardiovascular risk increases clearly from a value above 200 mm Hg.

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In Reply:

We thank your correspondents for their critical comments.

In response to Professor Ulmer: as indicated in the title of our article, the article was directed primarily at predominantly sports focused doctors. As regards the importance of exercise testing in occupational/military medicine, the stress-strain concept, the use of professional simulators, and activity analyses, we refer our readers to the standard literature (1–3). The main focus of our article was on cardiorespiratory fitness and endurance (without any direct reference to the wide range of different professional/vocational fields). This has been not been assessed to a satisfactory degree in exercise testing in the outpatient or inpatient setting. In

recent years, numerous studies have shown that physical fitness is of great prognostic importance with regard to disease and life expectancy.

Professor Kindermann touches on an important subject: the validity of the exercise ECG depends mainly on the prevalence, less on the pretest probability. The positive predictive value is much more reliable when considering the prevalence than the popular terms specificity and sensitivity.

Spiroergometry has a central role in scientific sports and exercise medicine/cardiology, but the method is rarely available in outpatient settings for sports medicine or general practice. Rather than discussing the well known criteria for peak performance once again, our focus is on the assessment of measured values in the submaximal range—as in our article. By doing so, pathological changes and training/therapy effects can be seen even in conditions of a far lower medical risk.

Training recommendations based on lactate thresholds have not been taken up in sports medicine practice. To cite Professor Ulmer (“Real professional or athletic performance can therefore not be measured by one single test ...”).

At peak performance, the blood pressure values of healthy top athletes can easily rise above 210 mm Hg and even reach 300 mm Hg (4). Where pathological events are suspected, additional diagnostic evaluation should follow as a matter of course.

Professor Weisser confirms some of our critical wording and claims.

Depending on the research question, therapy/training applied, and individual, several appropriate stress protocols exist. A consensus for ergometric stress tests is highly desirable, which might even facilitate setting up a nationwide fitness and health registry. We comprehensively confirm/support the importance of blood pressure at 100 watts.

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Conflict of interest statement

The authors of all contributions declare that no conflict of interest exists.