Lactate performance diagnostics at the Berlin Firefighters

For a long time now, lactate measurements have been established in professional sports. They are the basis for lactate performance diagnostics and make evaluations of physical fitness as well as a efficient design of workout possible.

In recent time lactate performance diagnostics have aroused the interest of amateur sport and therapeutic sport as well as occupational medicine and workplace health promotion.

The following report is about physicals with firemen, thus persons, who are exposed to extreme stresses and strains in their job, which demands a good constitution.

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Introduction:
„In the context of the „Sportförderprogramms der Feuerwehr Berlin“ (Sport support program of the berlin firefighters) the Dräger safety AG holds regularly perfomance tests with berlin firemen who use respiratory equipment.
These test series are performed as heart rate performance test on bicycle ergometer.
Aim of performance tests is the determination of the actual state of the physical fitness of public servants, who are newly admited to the program. Thereupon it is possible to give an individually tuned workout recommendation, which is coordinated to the respective goal of the individual fireman. These goals can be, for instance, the preservation of good physical fitness or reduction of existing performance deficits.
Performance of the subjects will be judged by the principle for respiratory equipment carriers (G26/3).
Because of the regular repeat of the tests in a half year rhythm the effectivity of the current workout recommodation and development of physical fitness can be gauged. Thereupon necessary adjustments of the workout recommodation can take place.
During the preceding test series in autumn 2005, in which approximately 500 public servants attened, a lactate performance diagnostics was performed simultaneously using a random sampling of 63 persons, who were selected partly at random and partly because of atypical heart rate courses.
Aim of this analysis was to approve or disprove the workout recommodation, which were determined per heart rate performance diagnostics, with the aid of the lactate performance diagnostics as well as to determine how the workout recommodation has to look like according to the lactate concentration for persons with peculiar heart rate courses, who are affected by medication against hypertension (normally beta blocker).“

Testing performance:
„A bicycle ergometry was performed as a graded exercise test.
Initial exercise stress was 50 watt and it was liable to an increment of 25 watt.
Duration of each grade amounted to 3 min. Maximal 300 watt could be achieved, since the Dynavit Ergometer reported an according maximum grade.
First blood sampling took place depending on expected final accomplishment, either at 75 watt (subjects with an accomplishment as far as 200 watt) or at 100 watt (subjects with an expected accomplishment above 200 watt). At every grade end blood sampling and corresponding heart rate was written down into the test record. Thus a sufficient quantity of samplings was guaranteed, which permits an analysis by LactWare® 3.9. Additionally, resting lactate value before the exercise stress test as well as recovery lactate value 10 min after test end was measured.
Blood was sampled from ear lobe. 10 µl blood per measurement were collected with a micro-pipette and it was ejected into the intened cuvettes with the aid of a micro-pipetter. Thus as far as 16 cuvettes placed in cuvette rack can be filled with samples, what the requirements of this test serie exceed.
Immediately after all sample preparations of each subject have been completed lactate values can be determined with the transportable Lactat- Photometer V 3.0. The device provides you with the opportunity to perform not only single but also serial measurements by as far as 20 samples at the same time. This permited a simultaneous evaluation of samples by two subject, exhibiting a significant saving of time.
Evaluation with Lactat- Photometer V 3.0 takes place as follows in two steps: First of all samples blank values will be measured. For this purpose filled sample cuvettes, which were mixed gently by inverting, are inserted one after another into the cuvette shaft of the device. Device will give a sound when measurement ends and next cuvette can be inserted. When all samples of a series (max 20) had been adducted for blank value measurement, the cuvette caps will be replaced by caps with reagent and then a comparison measurement with the Lactat- Photometer V 3.0 will be performed.
At the end of this measurement the lactate value of each sample can be read instantly on the display of the device. Thus it is possible to write the lactate value promptly down into the test record or to let the Diaglobal® Software read it out directly.
During this test the Software LactWare® 3.9 of Med- Tronik was used, which is also distributed by Diaglobal®. This software offers the examiner the opportunity to define his own threshold values besides the already pre-programed different threshold value models.
The program will determine the relevant training areas which are based on the determination of the individual anaerobic threshold (IAT), after input of personnel data of subject, test conditions, workout goal and workout state. It also gives a recommodation of an optimal stress disposition, if a defined weekly workout extent is used. Furthermore, the recuperativeness will be gauged, which in addition will infer to the fitness level of the subject.“

Findings:
The random sampling was divided into three sub-samples:
Group 1: Subjects, who met criteria G26/3 of the last test
(n=31)
Group 2: Subjects, who did not meet criteria G26/3 of the last test
(n=20)
Group 3: Subjects, who are affected by medication against hypertonie
(n=12)

It was possible to assign each subject to his individual anaerobic threshold (IAT) in the evaluation, which was executed according to the Freiburger Schwellwertmodell (Fribourg threshold value model). This permits the determination of the individual workout areas, so that in the future the subjects can attend to a heart rate orientated training, which considers their individual performance limits.

In general this test series certifys, that the IAT of endurance trained subjects with a high performance regarding watt per 1 kg body weight lies below the standard anaerobic threshold of 4 mmol lactate. In contrast, subjects, who do not train their endurance, have an IAT, which is higher than 4 mmol lactate.

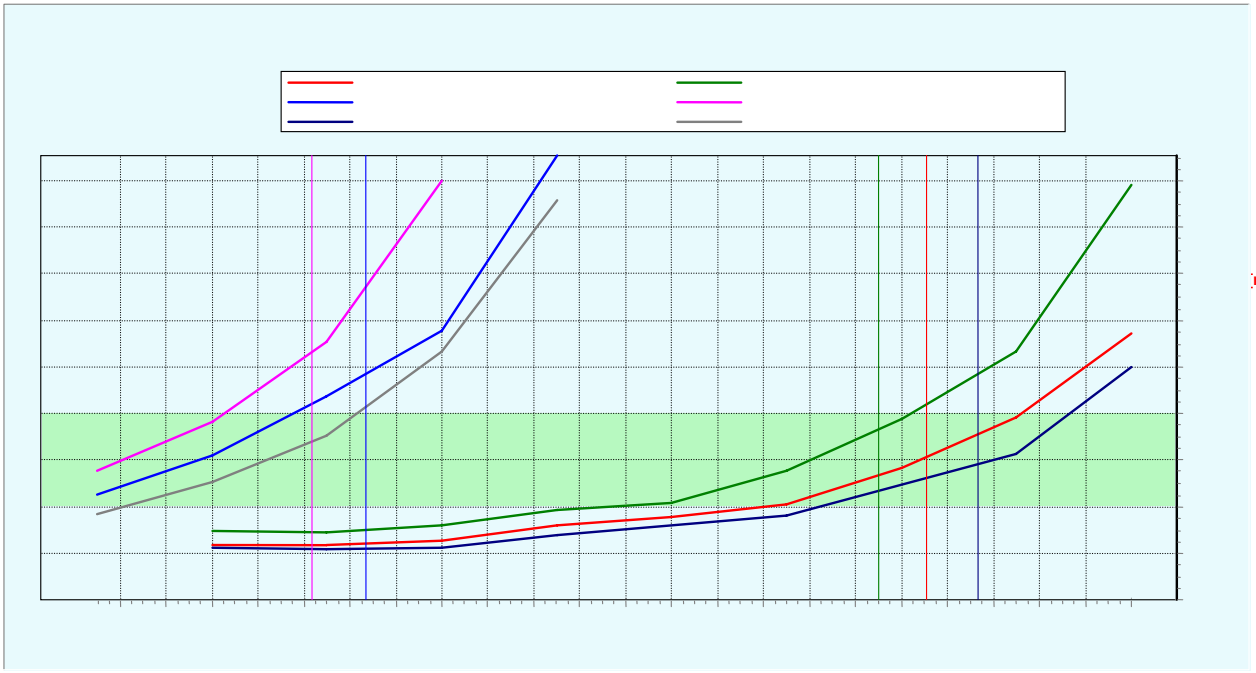

Fig. 1: Comparison high-performance/ low-performance

It is detectable that the lactate graphs reflect the individual proficiency level of subjects of group 3. The in part highly modified heart rate attitude hardly permits an assigment of workout areas, if lactate diagnostic is disregarded. Because of the determination of the IAT it is possible to make a better statement about this- although the workout areas often turn out small, which is based on the restricted heart rate upper limit.

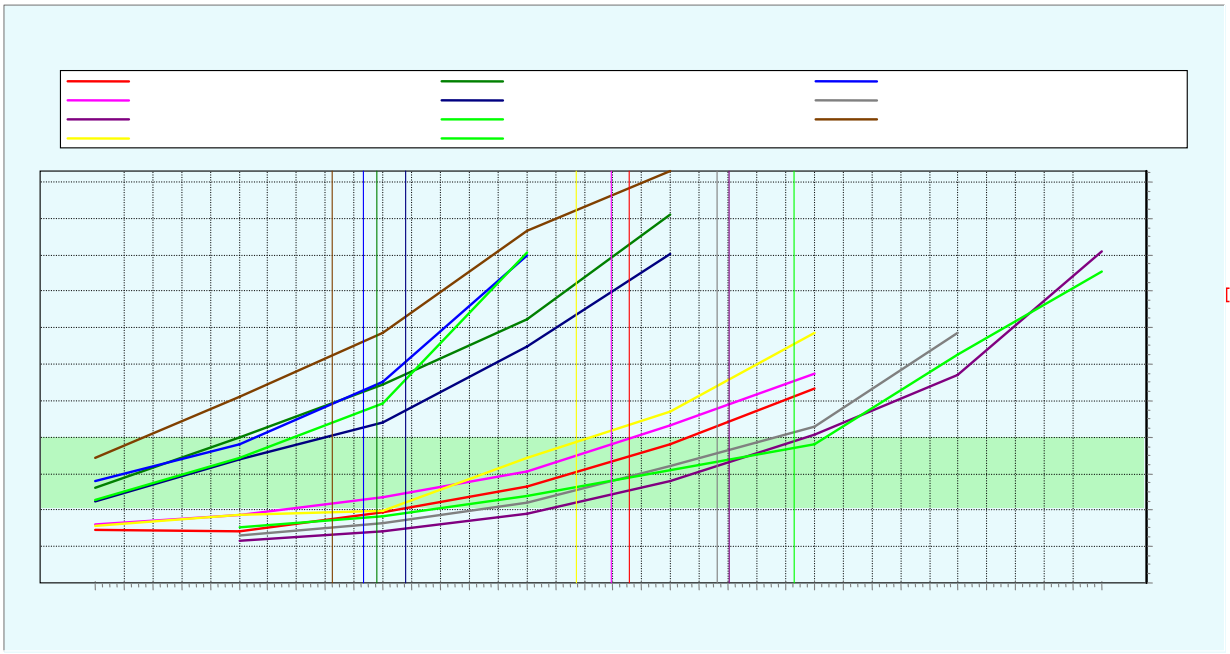

Fig. 2: Comparison of all subjects who use antihypertensive drugs

Conclusion:

„It is possible for the examiner to perform a lactate diagnostic fast and in almost every place, because of the uncomplicated handling of the Diaglobal® Lactat- Photometer V 3.0.

Since all neccessary means for work can be kept in an easy-to-handle case, the set is ideal for ambulant use, like in this case different fire stations. In addition, the prompt evaluation makes an following analysis of the test results with the respective subject possible.

The easy menu navigation and reliability of the displayed results make of the Diaglobal device a comfortable work equipment, which is easily manageable after a short familiarization.

I am grateful to the company Diaglobal®, in particular Mister Thakur, for the supply of device and analysis software. This helped me a great deal in bringing my generating of my diploma thesis foreward.“

Photos:

Blood sampling

Samples in cuvettes

Testing place at the fire station

Reading of the lactate values