Dragon boat: customizing the training plan

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Introduction

Athlete's muscle function during Dragon Boat practice requires activation of a complex kinetic chain (composed of a great number of muscles of all sizes, starting from dorsal muscles, abdominal muscles and muscles of the limbs). The Dragon Boat competition includes, during the sporting year, races with length spanning from about 40 seconds (200 meters) up to 10 minutes (2000 meters) and beyond, in specific distances (long distances). We couldn't locate sufficient scientific literature regarding the training of the crew. Therefore we wanted to initiate a new field of research in order to discover a training method that respects the physiological parameters of the various age groups of the crew

Methods

We monitored the production of lactic acid in athletes practicing Dragon Boat. After an adequate warm-up, the athletes were submitted to a training session which consisted of three maximal effort sets with a duration of 45"- 1' – 1'15" – 1' 30" – 1'15" - 1' - 45" with an active recovery time equal to the effort time and a total recovery period of 5' between two series.

The athletes were asked to perform consistently the scheduled work-out at the maximum of their ability, during each set. In the end of each set, blood sample from the earlobe was taken from ten athletes of various ages and training levels (average age 34 years and 10 months ± 9 years), who were chosen randomly before the beginning. The blood samples were analyzed by a piece of equipment named Lactate Plus Meter produced by the company Novabiomedical U.S.

The data were collected by approaching the Dragon Boat with a motor boat that was following the training at the stern in order to not disturb the athletes' effort with its waves. For this reason the athletes of the last rows were tested first and then gradually we moved up to those at the front row of the boat. The sample collection was completed within three minutes from the end of the session thanks to the coordinated work of the club's medical staff.

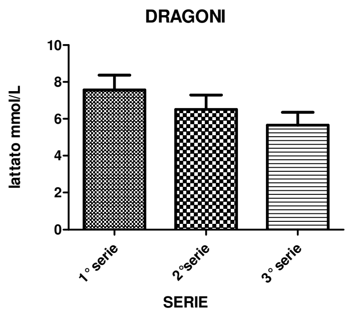
Results

In the following table the data collected in the three tests are shown, in chronological order, accompanied by the average of lactic acid concentration, the standard deviations (SD) and the differences (both as absolute number and as delta percentage) observed between the tests.

NAME	**SEX**	**AGE**	**ROW**	**SET 1**	**SET 2**	**DIFF.**	**DELTA %**	**SET 3**	**DIFF**	**DELTA % SEC. TEST.**
L.S.	M	33	9	7,7	4,3	3,4	44,15	4,8	-0,5	-11,63
P.M	M	32	9	9,9	6,6	3,3	33,33	6,3	0,3	4,54
G.R.	M	52	6	5,3	5,2	0,1	1,88	2,2	3	57,69
F.C.	M	30	5	7,6	6,5	1,1	14,47	5,7	0,8	12,30
F.B.	M	48	4	6,8	5,6	1,2	17,64	5,1	0,5	8,92
M.M.	M	32	4	11,7	10	1,7	14,53	7,2	2,8	28
E.C.	F	30	3	5,6	7,5	-1,9	-33,93	6,4	1,1	14,66
G.V.	M	21	1	8,5	9,1	-0,6	-7,05	8,1	1	10,98
D.V.	M	39	2	9,7	8,5	1,2	12,37	8,6	-0,1	-1,17
L.U.	F	31	6	2,9	1,9	1	34,48	2,2	-0,3	-15,78
AVERAGE		34y 10m		7,57	6,52	1,05	13,87	5,66	0,86	13,19
S.D.		9 y		2,56	2,41	1,61	22,60	2,18	1,20	20,83

The analysis of the data collected and the knowledge of each athlete's training history shows that the effort is greater in the first rows which have a higher rate of lactic acid even though they had more time to recover, before the sample collection.

The differences between the values are due to athletes' differences in training, age and above all their maximal capacity.
The average rate of lactic acid of the first set (average value 7, 57 ± 2, 56 mmol), is higher than that revealed in the second and third set, and it always remains, in average, well above the OBLA threshold.
In the second se we measured an average value of 6, 52 mmol of lactic acid ± 2, 41 with a delta, of the 22, 60% compared to the first sequence. In the third the average value of lactic acid was 5, 66 mmol ±2, 18 with a delta of 13, 19%, compared to the second test,
The whole data collection and the differences between delta percentages are, in our opinion, due to a response to our demand to perform three sessions at maximal effort (and for this reason the capacities were getting lower and lower due to the diminished buffer effect, described previously).



Discussion
The most important factor that affects the performance in short distances, where high exercise intensity is required, is the percentage of oxygen consumption at which the athlete is able to perform.
Tudor O. Bompa[1] defines this percentage as "*performance oxygen uptake*", underlying that the athlete's capacity is limited both by the lactic acid threshold and the VO_2 max. The "*performance oxygen uptake*" can therefore be considered as the greater effort capacity in which there is a balance between the production of lactic acid and the buffer substances existing in the muscle.
The high-intensity exercise endurance (HIEE) according to Bompa, has been shown to be able to delay the accumulation of the lactic acid in the blood, allowing a greater effort endurance (or power output).
Laursen and Jenkins[2] suggested that in order to train the muscle's ability to withstand a greater potency or duration of exercise, the athlete needs to perform multiple sessions of high intensity training (more than 80% of VO_2 max.), of various duration, intermitted by a recovery period of low intensity with a duration that varies between 60" and 4-5 minutes. The purpose of this training plan is to train the biochemical buffer system at the muscular level.
Spriet[3] demonstrated that the increase of hydrogen ions in the muscle, due to the increase of the muscle's lactic acid, causes the reduction of the phosphofructokinase enzyme activity. This fact reduces the muscle's ability to generate energy through the ATP's metabolic pathway (glycolysis).
From the analysis of the individual data collected it is evident that:

a) The effort was greater in the first rows athletes, even though they had some time to recover before the blood sample was taken. They presented a lactic acid rate constantly increasing between the sets, despite the fact that they were well trained athletes and they had already participated at the 2009 World Championship and 2010 European Championship.
b) In the last row athletes, lactic acid concentration was higher in the first set, but decreased rapidly during the second and third. This is probably due to the fact that the doctors' boat came from behind and for this reason last row athletes' blood was taken 5-10 seconds after the end of the workout. The higher rates of lactic acid in the first session are linked to the maximal effort exerted by the athletes, while in the other sets the well trained athletes managed to balance effort and recovery.
c) In the central rows there was an athlete who at the end of the first two sets had a rate of lactic acid above the average value (11, 7 in the first one, 10 the second one). The reason behind this fact is that M.M. has been training at high level only for a year and he has still a

limited aerobic capacity. This fact is obvious even during the endurance training in which he needs to perform at a sub- maximal percentage of VO_2. The discovery of this shortcoming allowed us to recommend a change to the training plan of the athlete, which should be more focused on the intensity rather than the quantity of the exercise.

d) In central rows (4-5-6) there were athletes of different ages but even though each of them had a different sport history before starting Dragon Boat racing, they managed to balance the effort between the sets keeping a stable lactic acid rate, but still higher than OBLA. G.R.'s low lactic acid value in the third session is, as G.R. himself said, due to a bad performance because of a "low energy reserve".

e) The values of L.U sitting in the sixth row require a special attention. These data were collected at the end, because of the difficult position of the athlete (towards the end of the 3rd minute of recovery). The timing of the sample collection along with the athletic history of the subject (well trained in endurance) justifies the particularly low values.

The general considerations that we can gather from these data is that Dragon Boat, as a team sport, pushes the beyond the fatigue limits, and therefore tends to increase considerably the level of the athletic training. The limit is that training has to be planned individually in order to avoid overtraining.

The data we collected, despite the fact that they should be appreciated in conjunction with the cardiac frequency of each athlete taken with a telemeter heart rate monitor, let the trainers give guidance to personalize and modify the training plan of each athlete in order to achieve the best performance possible.

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[1] Tudor O. Bompa, G. Gregory Haff "Periodization: theory and methodology of training" Ed. H Kinetics 2009

[2] Laurse P.B. and Jenkins D.G. The scientific basis for high-intensity interval training: optimising training programmes and maximising performances in highly trained endurance athletes. *Sports Med* 32: 53-73, 2002

[3] Spriet L.L., M.I. Lindinger, R.S. McKelvie, G.J. Heigenhauser and N.L. Jones Muscle glycogenolysis and H+ concentration during maximal intermittent cycling. *J Appl Physiol* 66: 8-13, 1989