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ANALYSIS OF ANAEROBIC CAPACITY IN ROWERS USING WINGATE TEST ON CYCLE AND ROWING ERGOMETER

Klašnja A, et al. Analysis of anaerobic capacity in rowers

Summary – The 30-s all-out Wingate test has been used in athletes of all sport specialties to measure the capacity for short duration, high power output while cycling. The aim of this study was to establish differences in measuring anaerobic capacity between the classic Wingate test on a cycling ergometer and the modified Wingate test on a rowing ergometer in rowers. A group of 20 rowers was tested by both the cycle and rowing ergometers during 30s of maximum power to test anaerobic capacity and to make correlation between these tests. The parameters measured were the peak power and mean power. The peak power on the cycling ergometer was 475±75.1W and 522.4±81W (p<0.05) on the rowing ergometer. The mean power on the cycling ergometer and the rowing ergometer was 344.4±51.1W and 473.7±67.2, (p<0.05) respectively. The maximum values were achieved at the same time on both ergometers, but remained on the higher level till the end of the test on the rowing ergometer. By correlating the anaerobic parameters of the classic Wingate test and a modified Wingate test on the rowing ergometer a significant positive correlation was detected in the peak power (r=0.63, p<0.05) as well as in the mean power (r=0.65, p<0.05). The results show that the rowers achieved better results of the anaerobic parameters on the rowing ergometer compared to the cycling ergometer due to a better mechanical efficiency. It is concluded that the modified Wingate test on the rowing ergometer can be used in rowers for testing their anaerobic capacity as a sport specific test ergometer since it provides more precise results.

Key words: Anaerobic Threshold; Exercise Test; Ergometry; Athletic Performance; Muscle Strength + physiology; Physical Endurance + physiology

Introduction

The human energy capacity consists of two main parts, aerobic and anaerobic, according to the nature of the energy yielding biochemical processes which take place in the cell. Characteristics of physical activity depend on the volume and rate of energy release necessary for physical activity and differ significantly in various forms and shapes of activity. The volume of the energy capacity and the level of its exploitation are significantly different among individuals. This is of particular importance for achieving top sports results. Energy capacity can be accurately measured in many ways.

The assessment of the anaerobic capacity can be conducted in several ways. The most common are the motor tests [1–3], determination of the maximum oxygen debt [4], and maximum oxygen deficit [5] and muscle biopsy [6]. The most commonly used test today is the Wingate anaerobic test. The Wingate test (WAnT) is widely used test for the comparison of anaerobic capacity between different sexes [7,8], age groups [9] and athletes [10,11]. The validity of the WAnT for measuring anaerobic capacity was proved many times in the past by correlating peak power and mean power on fields, in laboratories and also by histological analyses [3,12,13]. There is also a significant positive correlation between the Wingate test and other laboratory tests that measure the anaerobic capacity (oxygen debt and deficit) [14]. The assessment of anaerobic capacity by the Wingate test provides valuable information for determining the current state of physical fitness of the subject as well as for monitoring progress during training.

A cycle ergometer, as a tool for conducting WAnT, provides valuable information for measuring anaerobic capacity; however, there is still a question whether it depicts the real situation in various sport disciplines. For this reason, there is a need to assess anaerobic capacity on the principle of the Wingate test, performed on other more sport-specific devices.

The aim of this study was to determine the difference between the Wingate test on a cycle ergometer and a modified Wingate test on a rowing ergometer in rowers.

Material and methods

Subjects

The study involved 20 male rowers from the rowing club Danubius, Novi Sad, who volunteered to participate in the study. All subjects were healthy, as confirmed by the medical examination, and able to participate in the planned study. The anthropometric parameters (age, body weight - BW and body height - BH) were measured and data on the length of the sports experience were collected.

Experimental procedure

Cycling ergometer

WAnT is 30 seconds „all-out” test on a cycling ergometer. The maximum load is achieved by turning the pedals with maximal effort, and maintaining that power until the end of the test. The test is performed on a bicycle ergometer, and the subject is assumed to be seated in a normal cycling posture. The test is considered finished when the subject is no longer able to maintain the required pedaling frequency of 90 revolutions per minute (rpm) or when there is a significant reduction in the frequency of pedaling.

The test is performed on a bicycle ergometer, with the subjects wearing normal cycling clothing and shoes. The test is started at 40 W, and the load is increased by 20 W every 30 seconds until the subject is unable to continue at the required pedaling frequency of 90 rpm. The test is stopped when the subject is no longer able to maintain the required pedaling frequency of 90 rpm or when there is a significant reduction in the frequency of pedaling.

Rowing ergometer

The rowing ergometer is a piece of equipment that simulates the rowing motion, and is used to measure the power output of the rower. The test is performed on a rowing ergometer, with the subjects wearing normal rowing clothing and shoes. The test is started at 40 W, and the load is increased by 20 W every 30 seconds until the subject is unable to continue at the required pedaling frequency of 90 rpm. The test is stopped when the subject is no longer able to maintain the required pedaling frequency of 90 rpm or when there is a significant reduction in the frequency of pedaling.
Rowing ergometer

The modified Wingate rowing ergometer test (WATr) was performed on the Concept II rowing machine (Vermont, USA). The faster the subjects got the wheel spinning, the more resistance was generated. The WATr test was performed for 30 seconds and the results were processed in the software system of the device. The average power of contraction was measured by finding the mean value of individual contractions in each interval of 5 seconds. Six values were obtained within the interval of 30 seconds.

The subjects were familiar with the way of performing the test and before the main test they had done a trial testing on the rowing ergometer. The trial test lasted for 10 minutes and, as in the previous test on the cycle ergometer, the goal was to warm up the subjects and make them familiar with the test procedure.

The test started on the voice sign, after which the subjects performed their first contraction. After the first contraction the subjects were „rowing” for 30 seconds with the maximal strength. The movements on the rowing ergometer are the most similar to those performed in a rowing boat by rowers during a race.

Table 1 shows the group analysis of the basic characteristics of rowers. The results indicate the homogeneity of the measured parameters.

The testing of anaerobic capacity of rowers was carried out on the cycle ergometer and the rowing ergometer. The test results are shown in Tables 2 and 3.

The comparison of parameters of anaerobic capacity on the cycle ergometer and rowing ergometer is shown in Graph 1, according to which the rowers achieved significantly better results on the rowing ergometer. Statistically significant differences in favor of the rowing ergometer were obtained in parameters of maximum power (peak power - PP) and mean power (mean power - MP). The parameter MP on the cycle ergometer was 475.7±51.1W, while on the rowing ergometer it was 522.4±81W (P<0.05). The parameter MP was also significantly higher on the rowing ergometer (344.4W 473.7±67.2W, p<0.05). Dynamics of the load shows that the subjects reached the maximum value at the same time interval on both ergometers (2.75 of 5sec interval on the cycle ergometer and 2.8 of 5sec interval on the rowing ergometer, p<0.05). However, a higher drop in power during the test was recorded on the cycle ergometer, as shown in Graph 2.

By correlating the parameters of anaerobic capacity on the rowing and cycle ergometer a statistically significant positive correlation was found for the parameters of maximum power (r=0.63, p<0.05) and mean power (r=0.65, p<0.05).
Discussion

The success of athletes in each sport depends on the technical, tactical, physiological and psychological characteristics of the athletes. A sports score is determined by their mutual interaction and quality of these interactions. The share of individual components varies in different sports. That is why every sport must be considered separately. Hence, it is necessary to analyze the impact of individual components in a particular sport before the monitoring of training process begins.

Physiological abilities, such as aerobic and anaerobic capacity can be measured by various tests. The important thing in choosing the test is the selection of a relevant test for the activity of the individual, such as riding a bike for the cyclist or intermittent running test for the rower. It should also be known that laboratory tests provide general information about the physical fitness level of athletes, but rarely provide accurate data on the success of athletes on the sports field. To achieve a more accurate measurement of a performance it is better to use some of the field tests.

Uncoordinated movements lead to dissipation of energy. Therefore, a good training process is very important, especially in early childhood when people start with physical activity in different sports, since the dynamic stereotype is established at that early time.

There is a significant correlation between the conventional Wingate test on the cycle ergometer and a modified Wingate test on the rowing ergometer. The rowing ergometer is recommended to be used as a sport-specific ergometer due to increased mechanical efficiency during their use of specific muscles in rowing motions. The rowing ergometer is recommended to be used as a sport-specific ergometer for testing rowers as it provides more accurate results.

Conclusion

There is a significant correlation between the conventional Wingate test on the cycle ergometer and a modified Wingate test on the rowing ergometer. Rowers achieve better results of anaerobic capacity parameters on the rowing ergometer than on the cycle ergometer. The rowing ergometer is recommended to be used as a sport-specific ergometer for testing rowers as it provides more accurate results.

Literatura

Uvod
Wingate test je trideset-sekundni "all-out" test koji se koristi kod sportista svih sportskih specijalnosti za merenje anaerobnog kapaciteta tokom vožnje bicikl ergometra. Anaerobni kapacitet je odgovoran za kratke i intenzivne aktivnosti. Cilj rada je bio da se utvrdi razlika između Wingate testa na bicikl ergometru i simula- lacije Wingate testa na veslačkom ergometru kod veslača.

Materijal i metode
Ispitivano je 20 veslača kod kojih su mereni parametri anaerobne sposobnosti na bicikl ergometru i veslačkom ergometru, specifičnim za dati sport. Vršena je i korelacija između ova dva testa. Mereni su parametri maksimalne snage (Peak power) i srednje snage (Mean power).

Rezultati
Parametar maksimalne snage na bicikl ergometru je bio 475±75,1W, dok je na veslačkom ergometru bio 522,4±81W (p<0,05). Parametar srednje snage se takođe značajno razlikuje (344,4±51,1 W prema 473,7±67,2 W, p<0,05). Maksimalne vrednosti opterećenja su postignute u istom vremenskom periodu, ali su vrednosti zadržane na višem nivou na veslačkom u odnosu na bicikl ergometar. Korelacijom izmedju dva ergometra dobijena je visoka statistička značajnost u parametrima maksimalne snage (r=0,63, p<0,05) i srednje snage (r=0,65, p<0,05).

Diskusija
Dobijeni rezultati pokazuju da su veslači postigli značajno bolje parametre anaerobne sposobnosti na veslačkom ergometru u odnosu na bicikl ergometar. Korišćenje dva ergometra dobijena je visoka statistička značajnost u parametrima maksimalne snage (r=0,63, p<0,05) i srednje snage (r=0,65, p<0,05).

Zaključak
Veslački ergometar se može preporučiti za testiranje veslača kao sport specifični ergometar jer daje preciznije rezultate.

Ključne reči: Anaerobni prag; Testiranje tokom vežbi; Ergometrija; Performanse sportista; Mišićna snaga + fiziologija; Fizička izdržljivost + fiziologija

