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EVALUATION OF DISABLED SPORTSMAN ORGANISM FUNCTIONAL STATE AS THE ELEMENT OF REHABILITATION MEASURE SYSTEM

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Abstract:

The reaction of heart rate on a standard muscle strain and especially its recovery after the load completion is studied among disabled athletes. The analysis of heart rate was carried out in two stages. The heart rate indicators of disabled athletes at rest were examined during the first phase. During the second stage disabled athletes performed muscle strain in the form of shuttle acceleration for one minute along the basketball court perimeter, then the features of heart rate indicators were analyzed.

It was found that during the annual cycle of muscle training the values of heart rate among wheelchair basketball players change "by leaps and bounds". The highest heart rate values registered during the preparatory period are replaced by their significant reduction during the competitive period. It was revealed that the heart rate response to the execution of muscular load and HR recovery time after muscular exercise depends on the level of fitness. The higher the level of fitness among wheelchair basketball players, the less the HR reaction and the shorter the recovery time of heart rate. The lowest heart rate response to the execution of muscular load and simultaneously a rapid recovery of heart rate after the exercise is observed during competitive period. Maximum heart rate response to the execution of muscular load and a longer recovery of heart rate is observed during the preparatory period.

Keywords: disabled sportsmen, muscle exercises, heart response, recovery process.

1. Introduction

According to the World Health Organization with disabled people constitute about 10% of the world population. A long-term practice of domestic and foreign experts shows that the most effective method of their rehabilitation is the use of physical culture [1,4,7,10,12]. From a few studies which characterize the disabled sportsmen with the lesions of the musculoskeletal system, only a few are devoted to wheelchair basketball and are aimed mostly only at the training process improvement. Basketball as a sport discipline has its own characteristics, due to the nature of training

and fights -very speedy actions, often interrupted by pauses. Athletes who make the part of a basketball team in wheelchairs, have different causes of disability, the nature and the severity of life activity limitation. A variety of movements in the course of a game is determined by the coordinated movements of a body and hands. Athletes with the consequences of injuries or spinal cord diseases use most often only an upper body or loose limbs during the performance of technical actions, depending on the level and the extent of damage a limited number of muscles of a back and abdomen may be involved. The athletes with disabilities as the result of developmental disorders, such as cerebral spastic infantile paralysis, exhibit an unbalanced muscle tone, reflexes and actions against the growth development decrease. Individuals with various lesions of the musculoskeletal system have different morphofunctional and psychophysiological indicators which are studied insufficiently. A considerable research interest is to the study of heart pumping function change patterns at systematic trainings [2,3,5,6,8,11].

Systematic muscular workouts impose considerable demands on the body of disabled athletes. At that, there is a limited number of works devoted to the study of organism functions among wheelchair basketball players. Furthermore, the available literature has only a few works devoted to the study of heart functional capabilities among disabled persons during systematic muscle training.

The object of this article is the study of heart rate change peculiarities among disabled athletes at regular basketball trainings.

Research objectives:

1. To study the HR reaction among disabled athletes during the performance of muscular load at various stages of muscle training annual cycle;

2. To analyze the features of heart rate recovery after muscular load.

2. Study Methodology

The studies were conducted among disabled athletes of the basketball team "Leopard wings". The total number of examined athletes made 15 people. The study of cardiac pump function (CPF) indicators was conducted in two stages. CPF indicators of disabled athletes at rest were examined during the first stage. During the second stage disabled athletes performed muscle exercises in the form of shuttling acceleration for 1 minute along the basketball court perimeter. Then the recovery peculiarities of cardiac pump function were analyzed.

As in all kinds of sports the annual period of muscle training among wheelchair basketball players is conditionally divided into three periods: preparation, competition and transition periods.

In order to assess the difference validityof the standard values of Student t-criterion were used.

Rheogram registration method

Among the rheographic methods which determine heart rates, the most widely used method was the chest tetrapolar rheography method according to Kubicek [9] in various versions. The non-invasive nature of the technique, its simplicity and availability for practical use make it one of the most promising methods for heart rate determination.

Electrodes are applied according to the following scheme; 2 current electrodes: the first one - on the head in the forehead area, and the second - on the shank above ankle joint, two measuring electrodes: the first one - in the neck area at the level of the 7th cervical vertebra, the second one - in the chest area at the level of the xiphoid process.

The complex "Reodin - 500" used tetrapolar chest rheography as a basic medical procedure. The main advantages of this method is a high informativity, complete safety for a patient, the possibility of a long-term continuous monitoring, etc. Reo device for computer analysis RPKA 2 - 01 TU 9442-002-00271802-95 is designed for the operation in medical hardware and software systems.

The device is recommended for application in medical practice, by the Committee on new medical technology of the Russian Federation Ministry of Health. (Minutes № 5 dated on 13/06/2005). The certificate of conformity ROSS RU. 0001. 11IMO2 №3434630.

2. Study Results and Their Analysis

Heart rate (HR) at rest during the preparatory period (July - August) among disabled athletes engaged in wheelchair basketball made 83,2 ± 2,3 beats/min. Upon the completion of muscular load in the form of acceleration along the basketball court perimeter HR indicators during the first minute of the recovery process made 170,7 ± 2,2 beats/min. This value was greater by 87.5 beats/min as compared with the heart rate registered prior to the muscular load ($P<0,05$). Therefore, the performance of muscular load among wheelchair basketball players responded by 2 time increase compared with the original data. During the next minutes of recovery heart rate gradually decreased. During the second minute of rest HR decreased in comparison to the previous periods by 41.3 beats/min and made 129,4 ± 2,4 beats/min ($P<0,05$). During the third minute of recovery process in HR made 116,4 ± 2,5 beats/min. This value was less by 13.0 beats/min compared with HR values registered during the second minute of recovery process ($P<0,05$). During the fourth minute of recovery rate process HR indicators fell slightly more in comparison with the previous period and made 98,7 ± 2,2 beats/min, which is 17.7 beats/min less as compared with the HR values registered during the third minute of rest ($P < 0.05$). By the fifth minute of recovery process HR indicators decreased

by 14.3 beats/min compared with the previous period and made 84,4 ± 2,4 beats/min (P<0,05). Thus, by the fifth minute of recovery process HR indicators among wheelchair basketball players were set approximately at the level of initial values, i.e. HR recovery occurred.

Summarizing the foregoing, it can be noted that during muscular load performance HR values among wheelchair basketball players increase approximately two times in comparison with the original data. Then, HR values are reduced significantly. However, the pace of HR recovery during five minutes of rest are not the same ones. Thus, the most significant HR decrease is observed in the second minute of rest, where HR decreased by 41.3 beats/min (P <0,05). During the following minutes of rest, i.e. during the third minute of the recovery process the HR rate recovery pace slowed down. HR reduction at this stage made only 13.0 beats/min compared to the previous period (P<0,05). However, during the fourth minute of the recovery process HR reduction rates increased slightly and made 17.7 beats/min (P<0,05). By the fifth minute of rest HR decrease lowered down slightly and made 14.3 beats/min (P<0,05). Full HR recovery to original value level happened by the fifth minute of rest. Thus, during five minutes of rest after the completion of muscular HR indicators among wheelchair basketball players recover completely.

The heart rate during the competitive period (February-June) among disabled athletes engaged in wheelchair basketball made 74,4 ± 2,4 beats/min. Upon the completion of muscular load in the form of acceleration along basketball court perimeter HR performance during the first minute of recovery process made 120,1 ± 2,3 beats/min. This value was 45.7 beats/min greater as compared with the HR values registered prior to muscular load performance (P <0,05). Therefore, during the performance of muscular load by wheelchair basketball players the heart rate showed 1.6 times increase compared with the original data (P <0,05).

During the following minutes of recovery process heart rate gradually decreased. During the second minute of rest HR decreased in comparison to the previous period by 21.6 beats/min and made 98,5 ± 2,5 beats/min (P<0,05). During the third minute of recovery process HR made 76,8 ± 2,6 beats/min. This value was 21.7 beats/min less than the HR indicators registered during the second minute of the recovery process (P<0,05). During the fourth minute of recovery process HR indicators were established at the level of initial values, i.e., on the level of HR indicators registered before the muscular load.

Thus, by the fourth minute of rest HR indicators were recovered to the level of original values and made 73,6 ± 2,4 beats/min. During the fifth minute of recovery process HR indicators were not changed significantly as compared with the previous recovery period and made approximately 73,2 ± 2,2 beats/min.

Consequently, the wheelchair basketball players restore HR values restore by the fourth minute of rest after muscular load during the competitive period and do not undergo significant changes in the future. At that, it should be noted that the HR reduction during the first and the second minutes of rest were approximately equally expressed and made 21.6 beats/min.

Thus, during the competitive period the HR recovery happens more evenly after muscular exercise completion by wheelchair basketball players. Moreover, during the competitive period the heart rate response to the execution of muscular load was significantly lower as compared to the preparatory period. Thus, if during the preparatory period the difference between HR values before and during muscular load performance made 87.5 beats/min (2-fold increase), then it was significantly lower during the competition period and made only 45.7 beats/min (1.6-fold increase). The difference between these two values made 41.8 beats/min ($P < 0,05$).

According to our studies, the heart rate during the transitional period (July-August) among the disabled athletes prior to muscular load performance made 80,5 ± 1,5 beats/min. During the first minute of recovery period HR indicators made 145,6 ± 2,1 beats/min. This value was 65.5 beats/min greater as compared with the HR values registered prior to the muscular load performance ($P<0,05$). Therefore, during the performance of muscular load the heartbeat rate among wheelchair basketball players increased by 1.8 times during the transitional period as compared with the original data ($P<0,05$). The most significant HR decrease after muscular load occurred during the second minute of rest. Heartbeat rate decreased in comparison to the previous period of rest by 40.1 beats/min and made 105,5 ± 2,5 beats/min ($P<0,05$). During the third minute of the recovery process HR made 90,3 ± 2,3 beats/min. This value was 15.2 beats/min less as compared with the HR registered during the second minute of the recovery process ($P<0,05$). During the fourth minute of rest heart rate decreased to 85,7 ± 2,4 beats/min. This value was 4.6 beats/min less compared to the previous period of recovery process ($P < 0,05$). Approximately, heart rate decreased during the fifth minute of the recovery process by the same amount (4.1 beats/min), where HR values made 81,6 ± 2,3 beats/min ($P<0,05$). Thus, HR recovery to approximately initial values occurred during the fifth minute of rest.

Analyzing HR recovery after the muscle load among disabled athletes during the transition period, we identified the following features: during the transition period the nature of HR recovery has an "intermittent" nature, i.e., HR recovery is not a uniform one. The most pronounced decrease of HR during the transitional period is observed within the second minute of rest. During the fourth and the fifth minute of recovery period HR recovery were the least ones and approximately equally pronounced (they made 4,1-4,6 beats per minute on the average). HR response to

muscular load performance during the transition period was slightly higher than during the competition period. Full recovery period of HR after the muscular load during the transition is a slightly long one, i.e., HR decrease to the level of the original values occurs only by the fifth minute of rest, while during the previous period it was much earlier, i.e., during the fourth minute of recovery period.

Changes in heart rate among wheelchair basketball players

Record time	***Annual training stages***		
	preparatory	***competitive***	***transitional***
Original HR values	83,2±2,3	74,4±2,4	80,5±1,5
1st recovery minute	170,7±2,2*	120,1±2,3*	145,6±2,1*
2nd recovery minute	129,4±2,4*	98,5±2,5*	105,5±2,5*
3rd recovery minute	116,4±2,5*	76,8±2,6*	90,3±2,3*
4th recovery minute	98,7±2,2*	73,6±2,4	85,7±2,4*
5th recovery minute	84,4±2,4*	73,2±2,2	81,6±2,3*

*- the difference is valid in comparison with previous values ($P<0,05$).

2. Summary

Systematic muscular workouts impose considerable demands on the body of disabled athletes [1,3,4]. At that, there are a few works devoted to the study of disabled person organism functional capabilities. Furthermore, the available literature has extremely rare works devoted to the study of heart pumping function among disabled persons systematically engaged in muscle workouts.

A more complete understanding of the heart functionality of heart makes the conduct of heart studies directly during muscle load performance a reasonable one [2,6,7]. Moreover, the changes in the HR indicators during the recovery process, especially immediately after the cessation of muscular activity demonstrate important regulatory changes in a body [2,8,11]. Therefore, we examined the response of heart pumping function among disabled athletes to the performance of muscular load in the form of shuttle acceleration for one minute along the basketball court perimeter.

According to our research, HR values among wheelchair basketball players increased in 2 times approximately at muscular exercise performance during the preparatory period in comparison with the original data. HR decreased significantly after the muscular load, i.e. during the recovery period.

At that, the most significant HR decrease was observed during the second minute of rest, where the HR decreased by 41.3 beats/min (P <0,05). However, during the subsequent minutes of rest, i.e. during the third minute of recovery process the HR recovery process slowed down significantly, where HR decline MADE only 13.0 beats/min compared to the previous period (P<0,05). During the fourth minute of recovery process HR recovery were increased slightly and made 17.7 beats/min (P <0,05). During the fifth minute rest heart rate recovery slowed down again and made only 14.3 beats/min (P <0,05). HR reduction to original values approximately occurred by the fifth minute of rest. Thus, during the preparatory period, heart rate recovery has a wavy character after the muscular load. Within five minutes of rest after the muscular load HR indicators recover completely among basketball players.

During the competitive period the HR response to the execution of the muscle LOAD was significantly lower than during the competitive period.

Thus, if during the preparatory period the difference between HR values before and during muscular load made 87.5 beats/min (i.e. it made a 2-fold increase), it was significantly lower during the competition period and made only 45.7 beats/min (i.e. the increase made 1.6 times). The difference between these two indicators made 41.8 beats/min (P<0,05).

After the muscular load completion during the competitive period among wheelchair basketball players HR reduction occurs more uniformly as compared with the preparatory period. Moreover, HR recovery to original values approximately occurred by the fourth minute of rest.

During the transition period HR response to muscular load performance was slightly higher than during the competitive period and made 1.8 times. Moreover, after the muscular load the character of HR recovery was more uniform during transition period.

The most pronounced HR decrease was observed during the second minute of rest. During the fourth and the fifth minute rest HR recovery were the lowest one and made 4,1-4,6 beats/min, respectively. HR reduction to the level of the initial values during the transitional period occurred only during the fifth minute of rest.

3. Conclusions

1. During the annual cycle of muscle training, the values of heart rate among wheelchair basketball players change "by leaps and bounds". The highest HR registered during the preparatory period are replaced by their significant reduction during the competitive period. In the future, the increase of heartbeat rate values is observed once again during the transition period;

2. Heart rate response on muscular load performance and HR recovery period after the muscle load depends on the fitness level. The higher the level of fitness among wheelchair basketball players, the less the HR reaction and the shorter the recovery time of heartbeat rate.

Thus, the lowest heart rate response on the performance of muscular load and simultaneously a rapid recovery of heart rate after the completion of load is observed during the competitive period. Maximum heart rate response on the execution of muscular load and a longer recovery of heart rate is observed during the preparatory period.

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