REACTION FEATURES OF PUMP FUNCTION OF HEART OF WHEELCHAIR BASKETBALL PLAYERS ON THE MUSCULAR LOADING DEPENDING ON DEGREE OF LOSS OF THE LOWER LIMBS

CARACTERÍSTICAS DE LA FRECUENCIA CARDÍACA DE LOS JUGADORES DE BALONCESTO CON DISCAPACIDAD MOTRIZ EN LA CARGA MUSCULAR DEPENDIENDO DEL GRADO DE PÉRDIDA DE LOS MIEMBROS INFERIORES

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abstract

In this article, the response of the heart rate and stroke volume of disabled athletes to the standard muscular load was studied. The athletes of the basketball team are divided into two groups. The first groups are wheelchair basketball players with amputated lower limbs. The second group is wheelchair basketball players with lower limb atrophy. A comparative analysis of heart rate and stroke volume was performed at rest and when performing a muscular load. It has been revealed that basketball players with amputated lower limbs have heart rate indicators at rest significantly higher, and ASW is lower than basketball players with atrophy of lower limbs. It has been established that in basketball players with amputated lower limbs when performing a muscular load, large changes occur on the part of the stroke blood volume and the values of the heart rate change to a lesser extent. Whereas, athletes with atrophy of the lower extremities when performing muscular load, there are large changes in the frequency of heartbeats and to a lesser extent the indices of stroke blood volume change.

Keywords: wheelchair basketball players, muscular load, heart rate, stroke volume, recovery period, heart pump function.

En este artículo, se estudió la respuesta de la frecuencia cardíaca y el volumen sistólico de los atletas discapacitados a la carga muscular estándar. Los atletas del equipo de baloncesto se dividen en dos grupos. Los primeros grupos son jugadores de baloncesto en silla de ruedas con miembros inferiores amputados. El segundo grupo son los jugadores de baloncesto en silla de ruedas con atrofia de las extremidades inferiores. Se realizó un análisis comparativo de la frecuencia cardíaca y el volumen sistólico en reposo y al realizar una carga muscular. Se ha revelado que los jugadores de baloncesto con miembros inferiores amputados tienen indicadores de frecuencia cardíaca en reposo significativamente más altos, y ASW es menor que los jugadores de baloncesto con atrofia de miembros inferiores. Se ha establecido que en jugadores de baloncesto con miembros inferiores amputados cuando realizan una carga muscular, se producen grandes cambios por parte del volumen sanguíneo del accidente cerebrovascular y los valores de la frecuencia cardíaca cambian en menor medida. Mientras que los atletas con atrofia de las extremidades inferiores cuando realizan una carga muscular, hay grandes cambios en la frecuencia de los latidos cardíacos y, en menor medida, los índices de cambio en el volumen sanguíneo del accidente cerebrovascular.

Palabras clave: jugadores de baloncesto en silla de ruedas, carga muscular, frecuencia cardíaca, volumen sistólico, período de recuperación, función de bombeo cardíaco.

Introduction

Full biomedical and social rehabilitation of disabled people remains an acute problem of modern society. Long-term practice of work of domestic and foreign experts shows that the most effective method of their rehabilitation is the use of physical culture and sports [1,4,7,10,12,18]. The sports movement of persons with disabilities is represented by the Paralympic movement and a special program. The Paralympic program requires athletes regular training, participation in all major international competitions, and most importantly a certain level of sportsmanship. At the same time, against the background of the great achievements of national sports medicine, there is a significant gap in the issues of medical and biological support for disabled athletes who regularly engage in physical culture and sports. Constantly increasing norms to the level of physical fitness of athletes with disabilities, in our opinion, require consideration of both the individual characteristics of the athlete and the characteristics of injuries. Under the influence of intense sports loads in athletes with disabilities, mechanisms of adaptation and compensation for serious congenital or acquired pathologies are forming. At the same time, the mechanisms of urgent and long-term adaptation of athletes with disabilities to systematic muscle training are not well understood.

Of the few studies that characterize Paralympians with lesions of the musculoskeletal system, only a few are devoted to basketball in wheelchairs and are mainly aimed at improving the training process [13,14]. Basketball, as a sports discipline has its characteristics, which is due to the nature of training and fights - sharply speedy actions, often interrupted by pauses. Athletes who are part of a wheelchair basketball team have different causes of disability, the nature, and severity of the disability. Athletes with the consequences of injuries or diseases of the spinal cord when performing technical actions most often use only the upper shoulder girdle or loose limbs, depending on the level and degree of damage, a limited number of back and abdominal muscles can participate. Athletes with a disability due to developmental disorders, in particular, cerebral palsy, demonstrate unbalanced muscle tone, reflexes, and actions against the background of stunting. Persons with various lesions of the musculoskeletal system have different morphofunctional and psychophysiological indicators that are not sufficiently studied. Considerable interest among researchers is the study of patterns of changes in the pumping function of the heart during systematic muscle training [2,3,5,6,8,11,20]. When assessing the contractile properties of the myocardium in patients with lower limb stumps and lower limb atrophy, it should be borne in mind that the normal state of the systole phase structure in this cohort is different from the generally accepted norm for healthy people.

Systematic muscle training makes significant demands on the body of athletes with disabilities [2,13-15,19]. At the same time, the works devoted to the study of the functional capabilities of the organism of wheelchair basketball players are extremely limited. Moreover, the available literature rarely found work on the study of the functional performance of athletes with disabilities with various injuries during muscle training.

The purpose of these studies was to study the peculiarities of changes in the pumping function of the heart of wheelchair basketball players when performing a muscular load.

Objectives of the study

1. To study the heart rate and CRI at rest of athletes with disabilities with various injuries of the lower extremities;
2. To analyze the characteristics of the reaction of heart rate and CRM when performing muscular load, depending on the degree of lesion of the lower extremities.

Research Methodology

Studies were conducted among disabled athletes of the Wings of Barca basketball team. The total number of athletes surveyed was 20 people. Athletes were conditionally divided into two groups. The first group included athletes with amputation of the lower extremities (9 people). The second group consisted of 11 people with atrophy of the lower extremities. The study of indicators of the pumping function of the heart (NSF) was carried out in two stages. In the first stage, the NFS indicators of disabled athletes alone were examined. In the second stage, the disabled athletes performed the muscular load in the form of shuttle acceleration for 3 minutes around the perimeter of the basketball court.

To assess the reliability of differences, the standard values of the Student's t-test were used.

Rheogram registration technique.

Among rheography methods for determining the heart rate, the most widely used method is tetrapolar thoracic rheography according to Kubicek [10] in various modifications. The non-invasive nature of the method, its prostate and its availability for practical use make it one of the most promising methods for determining heart rate.

Electrodes are superimposed according to the diagram; 2 current electrodes: the first - on the head in the forehead, the second - on the lower leg above the ankle joint, 2 measuring electrodes: the

first - in the neck at the level of the 7th cervical vertebra, the second - in the chest at the level of the xiphoid process.
Chest tetrapolar rheography is used as a basic medical technique in the “Reodin - 500” complex. The main advantages of the method are high information content, complete safety for the patient, the possibility of continuous long-term monitoring, etc. The unit for computer analysis of RPKA 2 - 01 TU 9442-002-00271802-95 is designed to work as part of hardware-software complexes for medical purposes.
The device is recommended for use in medical practice by the Committee on New Medical Equipment of the Ministry of Health of the Russian Federation. (Minutes No. 5 of June 13, 2015). Certificate of Conformity ROSS RU. 0001. 11IMO2 №3434630.

Results of Research and their Analysis

Heart rate (HR) in athletes with disabilities with amputations of the lower extremities alone was 84.5 ± 1.8 beats/min. Upon completion of the muscular load in the form of acceleration along the perimeter of the basketball court for 3 minutes, the heart rate indices were 155.4 ± 2.1 beats/min. This value by 70.9 beats/min was higher compared with the HR parameters recorded before the muscular load was fulfilled (P <0.05). Consequently, to perform muscular load in wheelchair basketball players with amputations of the lower extremities, the heart rate responded by increasing the heart rate by about 1.8 times compared with the original data.
Heart rate in athletes with disabilities with atrophy of the lower limbs, the heart rate at rest was 75.7 ± 2.1 beats/min. Upon completion of the muscular load in the form of acceleration along the perimeter of the basketball court within 3 minutes, the heart rate indicators were 171.5 ± 2.0 beats/min. This value was 95.8 beats/min higher than the registered heart rate recorded before the muscular load was fulfilled (P <0.05). Consequently, to perform muscular load in basketball players with atrophied lower limbs, the heart rate responded to an increase in heart rate by about 2.2 times compared with baseline data (P <0.05).
Thus, it can be argued that in basketball with amputated lower limbs, heart rate indicators at rest, according to our data, were significantly higher than among basketball players with atrophy of the lower extremities. Further, it should be emphasized that athletes with amputated lower limbs, when performing muscular load in the form of shuttle acceleration around the perimeter of the site, responded by increasing the heart rate to 155.4 beats/min, then athletes with lower limb atrophy responded to the same load by increasing the heart rate to 171.5 beats/min The difference was 16.1 beats/min (P <0.05). Therefore, it can be argued that in wheelchair basketball players the response of the heart rate depends on the nature of the injuries of the athletes. The most pronounced response of the heart rate to the performance of muscle load was revealed by basketball players with atrophy of the lower extremities. Table 1 Indicators of heart rate of basketball players – wheelchairs at rest and when performing muscular load

Group of studied athletes	Heart rate alone	Heart rate when performing muscular load
Athletes with amputation of the lower extremities	84,5 ± 1,8	155, 4 ± 2,1 *
Athletes with atrophy lower limbs	75,7 ± 2,1	171,5 ± 2,0 *

*- the difference is significant compared with the previous value (P <0.05).

The stroke volume of blood (SV) was recorded at rest and when performing a muscular load. The stroke volume of disabled athletes with amputation of the lower limbs alone was 45.7 ± 1.9 ml. When performing muscular load, the SV was 85.4 ± 1.7 beats/min. This value by 39.7 ml was higher compared to the values of SV registered before performing the muscular load (P <0.05). Consequently, the systolic blood volume responded to an increase of about 2.0 times to the performance of muscular load in wheelchair players with amputations of the lower extremities, compared to the initial data.
The stroke volume of athletes with disabilities with atrophy of the lower extremities alone was 57.5 ± 2.1 ml. When performing muscular load in the form of acceleration along the perimeter of the basketball court, the SV indicators were 78.4 ± 1.6 ml. This value by 20.9 ml was higher compared with the values of SV registered before performing the muscular load (P <0.05). Consequently, the stroke volume of blood responded to an increase in muscle load in basketball players with atrophied lower limbs by about 1.3 times compared to the initial data (P

<0.05).

Thus, according to our data, in basketball players with amputated lower limbs, the SV indicators at rest were significantly lower than in basketball players with atrophy of the lower limbs. It should be emphasized that athletes with amputated lower limbs, when performing muscular load in the form of a shuttle acceleration around the perimeter of the site, responded by increasing the SV to 85.4 ± 2.0 ml, whereas athletes with atrophy of the lower limbs responded to the same load by increasing the SV up to 78,4 ± 1,6 ml. The difference was 7.0 ml (P <0.05). Therefore, it can be argued that in basketball players - wheelchairs, the response of the SV to the performance of muscular load depends on the nature of the lesion of the athletes' lower limbs. According to our data, in athletes with amputations of the lower extremities, the results of the SV reaction were slightly better compared with athletes with atrophy of the lower extremities.

Table 2

Indicators SV athletes - wheelchair sat to rest and when performing muscular load

Group of studied athletes	SV alone	SV when performing muscular load
Athletes with amputation of the lower extremities	45,7 ± 1,9	85,4 ± 1,7*
Athletes with atrophy of the lower extremities	57,5 ± 2,1	78,4 ± 1,6*

*- the difference is significant compared to the previous value (P<0,05).

Conclusion

Systematic muscle training makes significant demands on the body of athletes with disabilities [1,2,4,17]. At the same time, works devoted to the study of the functional capabilities of the body of persons with disabilities are few. Moreover, in the available literature, it is extremely rare to find works devoted to the study of the pumping function of the heart of people with disabilities who are systematically engaged in muscle training. For a more complete picture of the functional capabilities of the heart, it is advisable to research the activity of the heart directly while performing muscular loads [2,13-16]. Moreover, changes in heart rate indicators in the recovery process, especially immediately after cessation of muscle activity, indicate the most important regulatory changes in the body [2, 22]. In this regard, we investigated the reaction of the pumping function of the heart of disabled athletes to the performance of muscular load in the form of shuttle acceleration for three minutes around the perimeter of the basketball court.

As our studies have shown, in wheelchair players with various injuries during the performance of the muscular load and in the recovery process, we identified the following features:

- for basketball players with amputated lower limbs, heart rate indicators at rest turned out to be significantly higher, and WAF was lower than for basketball players with leg atrophy;
- basketball players with amputated lower limbs react to a muscular load with a lower HR response than athletes with atrophied lower limbs. So, if athletes with amputated lower limbs, when performing muscular load in the form of shuttle acceleration around the perimeter of the site, responded by increasing heart rate to 155.4 beats/min, athletes with lower limb atrophy responded to the same load by increasing heart rate to 171.5 beats/min. The difference was 16.1 beats / min (P <0.05).
- basketball players with amputated lower limbs react to a muscular load with a greater response from the ASC than athletes with atrophied lower limbs. So, if athletes with amputated lower limbs, when performing muscular load in the form of shuttle acceleration around the perimeter of the site, responded with an increase in AEC to 85.4 ml, athletes with lower extremity atrophy responded to an increase in AQI to only 78.4 ml. The difference was 7.0 ml (P <0.05).

Thus, summarizing the above, it can be noted that in wheelchair basketball players, the response of the heart rate and CRM to the performance of muscular load depends on the nature of the injuries of athletes. Athletes with amputated lower limbs are more responsive to changes in AVI than HR to the performance of muscular load. Athletes with atrophy of the lower extremities, these results were slightly lower.

Consequently, when planning and conducting the training sessions themselves, coaches need to take these physiological features into account and make certain adjustments to the process of sports training of wheelchair basketball players.

In our opinion, the increased heart rate at rest in amputees is explained by the constant specific load associated with daily walking. Sustained hyper circulation is a consequence of an increase in the tone of the sympathoadrenal system. Sustainable adaptation of the blood circulation system to the specific load associated with walking on prostheses. In the literature, there is also evidence that amputated persons have disinhibition of sympathetic mechanisms and an increase in vasoconstrictor adrenergic effects, which leads to changes in heart rate towards tachycardia [3, 21].

Findings

1. For basketball players with amputated lower limbs, the heart rate at rest is significantly higher, and the WAF is lower than that of basketball players with atrophy of the lower limbs.
2. Athletes with amputated lower limbs are more responsive to changes in stroke volume than to heart rate to perform the muscular load.
3. Athletes with atrophy of the lower limbs on muscle load react with large changes in heart rate and a smaller reaction of stroke blood volume.

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