Physiological reactions of the cardiovascular system in conditions of vestibular irritation in tennis players

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Dr. Biol., Professor **S.Yu. Zavalishina**[1]
PhD, Associate Professor **E.S. Kachenkova**[2]
PhD, Associate Professor **Yu.V. Zbrueva**[3]
Dr. Hab., Professor **G.N. Germanov**[4]
[1]Russian State Social University, Moscow
[2]Institute of Natural Sciences and Sports Technologies (Moscow City University), Moscow
[3]Astrakhan State Medical University, Astrakhan
[4]Russian State University of Physical Education, Sports, Youth and Tourism (SCOLIPE), Moscow

Corresponding author: alexm-77@list.ru

Abstract

Objective of the study was to identify the reaction of the cardiovascular system to vestibular irritation in tennis players with different lengths of sports experience.

Methods and structure of the study. 58 young tennis players (19.5±0.6 years old) were observed, regularly training for different periods: one year - 19 athletes, two years - 21 athletes, three years - 18 athletes. The control group (22 young men) consisted of clinically healthy volunteers (20.2±0.4 years) who had never been involved in sports before. The functional parameters of the heart and vascular system were recorded under conditions of vestibular load, using a rotational test with head tilts to the right and left. For data processing, Student's t-test was applied.

Results and conclusions. For the successful performance of motor actions in tennis, the level of development of the vestibular apparatus is very significant, which provides the brain with information about the localization of the body in space and the process of maintaining the necessary posture. Increasing the length of tennis training strengthens the cardiovascular system and stimulates vestibular stability. The maximum pulse stability was found in tennis players with three years of sports experience and the greatest experience in training situations associated with rapid movements at different angles. We can assume that playing tennis trains the cardiovascular system, ensuring the stability of its work under conditions of vestibular stimulation.

Keywords: *tennis, vestibular system, sports experience, cardiovascular system.*

Introduction. Dosed physical activity strongly stimulates metabolic and protective processes in the human body [2, 8]. An increase in motor activity enhances the functions of all internal organs [9]. The vestibular apparatus is always involved in the implementation of any movements, helping the body to maintain the optimum position in space and increasing the accuracy of the work of different muscle groups [7]. The normal functioning of the vestibular apparatus with its clear interaction with life support systems ensures the adequate implementation of any motor actions [10]. The level of development of the vestibular apparatus and the severity of its influence on the functioning of the cardiovascular system are of great importance for maintaining the optimum physical condition and ensuring high fitness in any sport [4, 6].

Objective of the study was to identify the reaction of the cardiovascular system to vestibular irritation in tennis players with different lengths of sports experience.

Methods and structure of the study. The study was conducted with the involvement of 58 young men (19.5 ± 0.6 years old) involved in tennis for various periods. Some of them systematically trained for one year (19 people), some for two years (21 people) and some for three years (18 people). The control group consisted of 22 completely healthy young men (20.2±0.4 years old) who had never been involved in sports before.

In the surveyed, the functional parameters of the cardiovascular system were recorded during stimulation of the vestibular receptors under the conditions of rotational tests according to the method of V.I. Voyachek. Changes in the cardiovascular system were registered for this sample by taking into account the pulse value and blood pressure figures. They were determined before and after the traditional rotational test (five rotations were performed within 10 s) and a modified test using head tilts to the right and left (five rotations within 10 s in a rhythm). Also, to increase the severity of the impact of the rotation process on the functional state of the vestibular apparatus, the time for performing a standard rotational test according to the Voyachek V.I. was doubled (performed 10 rotations for 20 s).

Results of the study and their discussion. The pulse value of tennis players with different sports experience was at the optimal level and reached 65.3±0.4, 62.7±0.68 and 60.1±0.42 beats/min, respectively. In the control group, this indicator was also normal, but slightly exceeded its values in athletes (73.4±0.87 beats/min).

The index of heart rate under the conditions of applied vestibular load in tennis players and in physically untrained young men of the control group showed an increase. In the course of the Voyachek test in the classical version, an increase in the number of heartbeats was found in tennis players who had one year of experience by 3.8 ± 0.56 beats / min, in those with two years of experience by 3.3 ± 0.61 beats / min, in those with three years of experience by 2.2±0.22 beats/min. In the control group, this value increased by 5.7±0.48 beats/min (see table).

Physiologically trained people are characterized by physiologically beneficial reactions of cardiac activity in conditions of a change in the location of their head in space, especially due to rotation. The development of adaptation of vestibular mechanisms in the course of performing movements in a tennis game is very effectively carried out under conditions of tilting the head to the side. In the study, it was noted that when the torso rotated with the head tilted in different directions, the reaction of the heart was different. Thus, the values of the pulse rate recorded under conditions of tilting the head to the right side were less than in conditions of performing the tilt of the head to the left.

The found differences in the severity of the pulse response in athletes with different sports experience were small, but turned out to be statistically significant. Obviously, this is due to a change in the degree of physical fitness among tennis players on the right side of the body (all those taken into the study were right-handed) as their sports experience increased. This can be explained by the need for frequent changes in the position of the head in space during tennis training, adaptation to which occurs with the growth of sports experience. So, with the experience of three years, the athletes had the least response of the pulse to the rotation in terms of tilting the head to the right (2.4±0.12 beats/min). Apparently, due to the higher experience of motor activity with elements of rotational influence, tennis players with a three-year experience had the greatest adaptation of the heart to sports loads [5].

In the study conducted among tennis players with different duration of sports experience, the dynamics of the pulse value was assessed under the influence of a rotational load of different duration. With a doubling of the period of vestibular influence, the pulse in physically untrained people increased without strict proportionality to the increase in the number of rotations. The dependence found in all groups of tennis players was inverse: the less pronounced was the reaction to the impact of five revolutions, the stronger it

Changes in the heart rate in tennis players under the influence of different variants of vestibular stimulation

Groups of surveyed	Increase in heart rate, M±m			
	Standard option	5 rotations for 10 s when tilted to the left	5 spins throughout 10 s when tilted to the right	10 spins throughout 20 s without lateral tilt
Control group (n=21), bpm	5,7±0,48	6,8±0,45	5,8±0,52	9,7±0,75 p_2<0,01
Tennis players with 1 year experience (n=19), bpm	3,8±0,56 p<0,01 p_1<0,01	4,9±0,32 p<0,01 p_1<0,01	3,8±0,29 p<0,01 p_1<0,01 p_2<0,01	6,2±0,53 p<0,01 p_1<0,01
Tennis players with 2 years of experience (n=21), bpm	3,3±0,61 p<0,01 p_1<0,01	4,2±0,36 p<0,01 p_1<0,05	3,0±0,27 p<0,01 p_1<0,01 p_2<0,01	5,7±0,42 p<0,01 p_1<0,01
Tennis players with 3 years of experience (n=18), bpm	2,2±0,22 p<0,01	3,2±0,18 p<0,01	2,4±0,12 p<0,01 p_2<0,01	4,6±0,39 p<0,01

Note: p is the significance of differences between the control and athletes, p1 is the significance of differences between tennis players with a three-year experience, on the one hand, and athletes with an experience of 1 and 2 years, on the other hand, p2 is the significance of differences in indicators with different head positions in space.

was to the influence of 10 revolutions (with one year of experience - 63.1%, with two years of experience - by 72.7%, with three years of experience - 2.1 times).

In athletes with one year of experience, during the standard test, the increase in heart rate reached 3.8±0.56 beats/min, and in the case of 10 revolutions, this figure was 6.2±0.53 beats/min. For those who had two years of experience, these figures were 3.3±0.61 beats/min and 5.7±0.42 beats/min, respectively. For tennis players with three years of experience, these parameters were respectively 2.2±0.22 beats/min and 4.6±0.39 beats/minute. It becomes clear that the reaction of the heart in tennis players with maximum sports experience is very economical. This intensifies the blood flow in the tissues of athletes under conditions of complication of sports load to a strictly necessary degree [1, 3].

The values of systolic blood pressure in tennis players with one year of experience (114.6 ± 0.49 mm Hg. Art.), with two years of experience (110.5 ± 0.63 mm Hg. Art.) and with three years of experience (109.5±0.45 mm Hg. Art.) were at the normal level. This indicator was somewhat higher in the control group - 126.3±1.28 mm Hg. Art. ($p<0.05$), being also within the normal range.

During rotational exposure, systolic blood pressure increased at any location of the head in space. The degree of increase in systolic blood pressure in physically untrained young men and in all groups of athletes was comparable: 4.3±0.49 mm Hg. Art., 4.0±0.45 mm Hg. Art., 3.8±0.41 mm Hg. Art. and 3.7±0.52 mm Hg. Art., respectively. The found changes in the level of systolic blood pressure under conditions of different variants of rotational impact in athletes of all study groups remained, despite changes in the position of the head in space, in athletes included in all study groups.

When performing a test with a two-fold lengthening of rotation, tennis players with different sports experience increased in systolic blood pressure, approximately 23.0% higher than in a standard test. The increase in systolic blood pressure with a twofold lengthening of the rotational impact in physically untrained was 72.0% ($p<0.01$) higher than in all groups of athletes.

The levels of diastolic pressure in all groups of tennis players did not differ significantly, reaching an average of 67.5±1.96 mm Hg. Art. (in the group of physically inactive 82.1±0.57 mm Hg. Art.). The severity of changes in the value of diastolic blood pressure in all types of rotational exposure slightly increased in all groups of tennis players. The obtained results give grounds to believe that as the tennis players' sports experience increases, the overall functional reserves and the severity of the adaptation of the heart and vascular system to the influence of any rotational loads increase.

Conclusion. Systematic tennis training increases the body's adaptation to vestibular loads and increases the functionality of the myocardium. Regular tennis training helps to reduce the response of the pulse to rotational movements with a change in the position of the head in space. In tennis players, as their sports experience increases, the functional stability of the work of the heart muscle increases under conditions of any vestibular stimulation. Probably, an increase in the experience of sports activities in tennis increases not only the overall fitness, but also the resistance of the heart to any irritation of the vestibular receptors that occurs during training.

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