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FEATURES OF RHEOVASOGRAPHIC PARAMETERS OF THE TIBIA IN VOLLEYBALL PLAYERS OF A HIGH LEVEL OF SKILL OF THE YOUTH AGE

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ABSTRACT

Aim of the work was to determine the peculiarities of rheographic parameters of the tibia in volleyball players of the general group and individual somatotypes.

Materials and Methods: A comprehensive examination of 108 highly skilled volleyball players and 130 practically healthy girls aged between 16 and 20 years who did not play sports was conducted. The rheovasographic parameters of the tibia were determined using tetrapolar reocardiography on a computer diagnostic complex with the assessment of amplitude, time, and indicators of the ratio of amplitude and time rheovasographic parameters. A somatotypological study was conducted based on a calculated modification of the Heath-Carter method (1990) with the division of volleyball players and non-athletes into 4 constitutional groups: mesomorphic, ectomorphic, ecto-mesomorphic, and intermediate type.

Results: Significant differences in the value of individual amplitude and most tibia rheovasographic parameters between volleyball players and girls of the control group were revealed. In athletes, the amplitudes of the systolic, diastolic and rapid blood filling, the duration of the rheographic wave, the time of the ascending and descending parts of the rheogram and slow blood filling were statistically significantly higher. Somatotypological features of peripheral hemodynamic indicators were determined in volleyball players; the greatest differences in the indicators of regional blood circulation on the tibia were recorded for representatives of the ectomorphic somatotype;

between volleyball players and non-athletes with ecto-mesomorphic somatotype, there was no significant difference in the value of all tibia rheovasographic parameters.

Conclusion: Systematic training and competitions lead to prominent changes in rheovasographic indicators of the tibia in young female volleyball players, which are manifested by a better state of capillary and venous blood filling of the tibia muscles, but at the same time a reduced speed of regional blood flow due to a reduced tone of the vascular wall of small and medium arteries.

KEY WORDS: peripheral hemodynamics, reogravasography, tibia, somatotype, volleyball players, youth

INTRODUCTION

In modern sports, in order to achieve high results, the athlete's technical and tactical skills must be based on the perfect functioning of his or her cardiovascular system [1, 2]. Numerous scientific studies argue the importance of central hemodynamic indicators for sports performance [3, 4] and note the peculiarities of these parameters in representatives of various sports [5, 6]. Some scientists draw attention to the importance of taking into account the state of peripheral blood circulation [7-9], because the state of the vascular wall, blood supply and microcirculation of skeletal muscles, especially of the lower limb, can be a limiting factor for the successful implementation of a sports career [10]. During physical exercises, the most significant changes in blood supply are characterised for the blood circulation of skeletal muscles, therefore, the state of peripheral vessels is of great importance for the development of adaptive reactions to sports loads. The study of the physiological mechanisms of adaptation of regional blood circulation indicators in athletes of a specific sport during certain types of muscle work plays an important role both for experimental and clinical practice. Rheovasography (plethysmography) remains one of the non-invasive, simple, accessible diagnostic methods for assessing the efficiency of blood supply to the limbs and is included in the protocols of the USA and other countries of the world for screening examinations both in athletes and in the general population [11, 12].

In the practice of sports medicine, determining the state of peripheral vessels is of primary importance for indication of the pre-pathological and pathological conditions, admission to further training and competition activities, and it will allow to adequately determine the dependence of the

hemodynamic profile of the athlete and the level of his sports preparation [13]. At the same time, it is necessary to take into account the type of sport, gender and age of the athlete and his constitutional features, because there is convincing evidence of somatotypological conditioning of many morpho-functional indicators of the cardiovascular system [14 - 16].

The aim of the work was to determine the differences in the value of time, amplitude and ratios of amplitude and time rheographic parameters of the lower leg between groups of volleyball players and girls who did not play sports, within individual somatotypes and in general.

AIM

The aim of the work was to determine the peculiarities of rheographic parameters of the tibia in volleyball players of the general group and individual somatotypes.

MATERIALS AND METHODS

Based on the scientific laboratory of the National Pirogov Memorial Medical University (VNMU), we conducted an examination of 108 volleyball players between 16 and 20 years old. The average age in this group of female athletes was 18.05 ± 1.39 years. The age distribution among volleyball players was as follows: 16-year-olds – 20 persons (18.52%); 17-year-olds – 18 (16.67%); 18-year-olds – 28 (25.92%); 19-year-olds – 20 (18.52%); 22 (20.37%) of 20-year-olds. All the sportswomen had a high level of sportsmanship: 8 persons (7.41%) had 2nd adult class, 61 (56.48%) 1st adult class, 27 (25.00%) master of sports candidates, 27 (25.00%) masters of sports 12 (11.11 %). The average sports experience of female volleyball players was 6,361 ± 2,866 years.

Volleyball players were studied during the competitive period of the macrocycle, at least 12 hours after training loads. All athletes underwent a preliminary echocardiographic and electrocardiographic examination. Volleyball players who showed signs of overtraining and overstrain of the cardiovascular system were excluded from further research and were not included in the observation group. Exclusion criteria were hypertension, arrhythmias, II-III degree regurgitation, severe myocardial hypertrophy.

From the database of the scientific research center of VNMU, 130 practically healthy girls of the same age who did not play sports were selected, and they made up the control group. The average age in this group was 17.91 ± 1.49 years. The age distribution of girls in the control group was as follows: 16-year-olds - 30 persons (23.08%); 17-year-olds – 30 (23.08%); 18-year-olds – 22 (16.98%); 19-year-olds – 17 (13.08%); 20-year-olds – 31 (23.84%). The conclusion about the state of health of the girls of this group was made after a complex clinical and laboratory examination (echocardiography, sonography of the thyroid gland, kidneys, bladder, spleen, liver, gall bladder, X-ray of the chest; spirography, tetrapolar rheography. In order to decrease the influence of the hormonal state on hemodynamic parameters, we examined the girls during a period - from the 5th to the 12th day of the ovulatory-menstrual cycle, counting the day of the onset of menstruation as the first day of the cycle. The rheovasographic parameters of the tibia in volleyball players and girls of the control group were determined using tetrapolar rheocardiography on a computer diagnostic complex, and the amplitude, time and ratio indicators of the amplitude and time rheovasographic parameters were evaluated. The anthropometric study was carried out according to the method of V.V. Bunak [17], the somatotypological study - according to the calculated modification of the Heath-Carter method [18].

After somatotyping, it was established that 28 volleyball players and 33 girls of the control group belonged to the mesomorphic type of constitution, 27 girls of the first group and 36 of the second group belonged to the ectomorphic type, 27 volleyball players and 24 non-athletes belonged to the ecto-mesomorphs, and 26 volleyball players and 37 girls belonged to the medium intermediate type control group.

The analysis of the obtained results was carried out in the licensed package Statistica 5.5 using nonparametric methods of estimation of indicators.

RESULTS

We have established that the most of the amplitude rheovasographic indicators of the tibia are comparatively larger in volleyball players (Table 1). Only the value of the basic impedance and the amplitude of the incisura practically did not differ between the comparison groups. While the amplitudes of systolic and diastolic waves and rapid blood filling in volleyball players were significantly higher than in the control group (in all cases $p<0.05$).

We have established that most of the tibia amplitude rheovasographic parameters are comparatively higher in volleyball players (Table 1). Only the value of the basic impedance and the amplitude of the incisure practically did not differ between the comparison groups. While the systolic and diastolic waves amplitudes and rapid blood filling in volleyball players were significantly higher than in the control group (in all cases $p<0.05$).

In volleyball players of a high level of sportsmanship, all time indicators of the tibia rheovasogram, except for the time of rapid blood filling, were higher than in non-athletes girls (Table 1). It was found that the duration of the rheovasographic wave, the time of the ascending and descending part of the rheogram, and the slow blood filling of the tibia vessels were statistically significantly higher in volleyball players than in the control group (in all cases $p<0.001$).

We found that the integral indicators, which illustrate the ratio of the amplitude and time parameters of the tibia rheovasogram, do not reliably differ between volleyball players and non-athletes. In most cases, the average values of indicators of this group are lower in volleyball players, with the exception of the value of the diastolic index (Table 1).

In order to study the influence of the constitutional features or the specifics of sports activity, we compared the tibia rheovasographic indicators of the individuals in the same somatotype. It was found that most of the

Table 1. Indicators of the rheovasogram of the tibia in volleyball players and non-athletes (M±σ)

Radiographic indicators	Control (n=130)	Volleyball players (n=108)	p
Amplitude indicators (Om)			
Z	88.18±14.37	88.13±14.17	0.971
H1	0.055±0.0141	0.059±0.014	<0.05
H2	0.021±0.069	0.021±0.010	0.479
H3	0.022±0.010	0.024±0.008	<0.05
H4	0.023±0.006	0.025±0.007	<0.05
Time indicators (s)			
C	0.854±0.120	0.932±0.152	<0.001
A	0.139±0.018	0.148±0.023	<0.001
B	0.715±0.115	0.784±0.143	<0.001
A1	0.056±0.018	0.060±0.023	0.095
A2	0.083±0.011	0.088±0.010	<0.001
Indicators of ratios of amplitude and time parameter			
H2H1 (%)	36.95±17.36	34.22±13.49	0.665
H3H1 (%)	39.10±10.78	40.47±8.77	0.167
H4A1 (Om/s)	0.440±0.134	0.445±0.125	0.619
H1H4A2 (Om/s)	0.395±0.109	0.388±0.096	0.922
AC (%)	15.98±2.55	15.63±2.64	0.218
A1C (%)	6.058±1.961	5.931±2.112	0.250
A2C (%)	9.389±1.792	9.176±1.733	0.342
A1A2 (%)	69.34±27.84	69.29±31.79	0.587

Note: Here and later: Z – basic impedance, H1– systolic wave amplitude; H2 – amplitude of the incisure; H3 – diastolic wave amplitude; H4 – fast blood filling amplitude; C – reographic wave duration; A – time of the ascending part; B – time of the descending part; A1 – rapid blood filling time; A2 – slow blood filling time; H2H1 – dicrotic index; H3H1 – diastolic index; H4A1 – average speed of fast blood filling; H1H4A2 – average speed of slow blood filling; AC – tonus of all arteries; A1C – large diameter artery tonus indicator; A2C – indicator of arteries tonus of medium and small diameters; A1A2 – indication of the artion tones ratio.

Table 2. Amplitude and time parameters of the tibia reovasogram in individuals with mesomorphic and ectomorphic somatotypes (M±σ)

Indicators	Mesomorphic somatotype		Ectomorphic somatotype	
	Control	Volleyball players	Control	Volleyball players
Amplitude indicators (Om)				
Z	83.52±12.26	83.63±12.07	95.45±16.63	95.42±16.65
H1	0.049±0.009	0.056±0.013*	0.055±0.011	0.064±0.016*
H2	0.021±0.013	0.019±0.008	0.023±0.011	0.026±0.013
H3	0.021±0.008	0.022±0.007	0.023±0.008	0.028±0.009
H4	0.020±0.004	0.023±0.005	0.024±0.007	0.028±0.007*
Time indicators (s)				
C	0.862±0.153	0.887±0.153	0.836±0.131	0.927±0.164*
A	0.136±0.017	0.148±0.023*	0.141±0.019	0.149±0.027
B	0.726±0.151	0.738±0.142	0.695±0.122	0.778±0.146*
A1	0.055±0.015	0.057±0.023	0.061±0.019	0.064±0.029
A2	0.081±0.011	0.091±0.013**	0.080±0.010	0.085±0.009**

*Note: Here and later: * – p<0,05; ** – p<0,01;*

Table 3. Indicators of the ratios of amplitude and time parameters of the tibia reovasogram in individuals with mesomorphic and ectomorphic somatotypes (M±σ)

Indicators	Mesomorphic somatotype		Ectomorphic somatotype	
	Control	Volleyball players	Control	Volleyball players
H2H1 (%)	40.65±21.81	33.711±10.84	40.47±17.20	38.88±16.18
H3H1 (%)	40.88±11.60	38.29±6.00	41.05±11.48	43.00±11.00
H4A1 (Om/s)	0.396±0.119	0.421±0.114	0.427±0.089	0.481±0.146
H1H4A2 (Om/s)	0.355±0.082	0.363±0.093	0.391±0.076	0.421±0.111
AC (%)	15.63±3.09	16.56±2.64	16.60±2.59	15.74±2.35
A1C (%)	5.961±1.549	6.00±2.13	6.783±2.136	6.320±2.203
A2C (%)	9.192±2.227	9.962±1.989	9.333±1.816	8.940±1.679
A1A2 (%)	69.61±22.74	65.02±30.75	77.60±29.14	77.52±42.04

Table 4. Amplitude and time parameters of the tibia reovasogram in patients with ecto-mesomorphic and medium intermediate somatotypes (M±σ)

Indicators	Ecto-mesomorphic somatotype		Medium intermediate somatotype	
	Control	Volleyball players	Control	Volleyball players
		Amplitude indicators (Om)		
Z	84.62±10.22	88.42±12.71	90.95±14.92	86.87±13.71
H1	0.059±0.012	0.059±0.015	0.061±0.019	0.057±0.014
H2	0.016±0.003	0.019±0.008	0.024±0.015	0.019±0.013
H3	0.020±0.004	0.024±0.007	0.026±0.014	0.025±0.009
H4	0.023±0.005	0.025±0.007	0.025±0.008	0.024±0.009
		Time indicators (s)		
C	0.861±0.114	0.942±0.149	0.864±0.106	0.962±0.134*
A	0.139±0.009	0.146±0.019	0.137±0.018	0.146±0.027
B	0.722±0.116	0.796±0.145	0.727±0.103	0.816±0.126*
A1	0.052±0.012	0.060±0.020	0.053±0.016	0.057±0.024
A2	0.087±0.012	0.086±0.008	0.084±0.010	0.089±0.010*

amplitude indicators of the tibia did not have significant differences between non-athletes and volleyball players of the mesomorphic somatotype. Only the systolic wave amplitude in the group of female athletes was higher ($p<0.05$) than in the control group (Table 2). The average values of most amplitude indicators, with the exception of the amplitude of the incisure, are higher in mesomorph volleyball players.

In sportswomen with an ectomorphic somatotype, the average values of the amplitude indicators of the tibia rheovasogram, with the exception of the value of the basic impedance, are larger than in the girls-ectomorphs of the control group. Statistically significant differences were established for the systolic wave amplitudes and rapid blood filling (in both cases $p<0.05$) (Table 2).

We established that the time of the ascending part of the rheovasogram ($p<0.05$) and the slow blood filling of the tibia vessels ($p<0.01$) were significantly longer in volleyball players of the mesomorphic somatotype than in girls who did not play sports of the same somatotype (Table 2). Other time indicators had larger average group values, although the difference was not reliable when compared. Representatives of the ectomorphic somatotype had significant differences in the value of the time indicators of the tibia rheovasogram. It was found that in volleyball players of this somatotype, the duration of the rheovasographic wave ($p<0.05$), the time of the descending part ($p<0.05$) and slow blood filling ($p<0.01$) of the tibia rheovasogram are higher with the compared control group (Table 2).

It was established that the ratios of the amplitude and time parameters of the tibia rheovasogram in volleyball players and girls of the control group with mesomorphic and ectomorphic somatotypes did not differ statistically significantly (Table 3).

We did not determine a reliable difference when comparing the amplitude and time indicators of the tibia rheovasogram in volleyball players and girls of the control group with ecto-mesomorphic somatotype, although it should be noted that the athletes had higher average group values of these parameters (Table 4).

In volleyball players with an intermediate somatotype, all amplitude indicators are higher than in controls, but no significant differences were indicated. The time indicators of the tibia rheovasogram had a significant difference

Table 5. Ratios of amplitude and time parameters of the tibia reovasogram in individuals with ecto-mesomorphic and medium intermediate somatotypes (M±σ)

Indicators	Ecto-mesomorphic somatotype		Medium intermediate somatotype	
	Control	Volleyball players	Control	Volleyball players
H2H1 (%)	27.31±5.91	33.43±13.42	36.53±14.29	32.16±13.98
H3H1 (%)	34.54±7.37	39.40±8.97	41.21±11.48	42.32±8.35
H4A1 (Om/s)	0.462±0.105	0.446±0.137	0.493±0.169	0.437±0.101
H1H4A2 (Om/s)	0.419±0.091	0.400±0.097	0.430±0.146	0.371±0.081
AC (%)	15.92±2.59	15.32±2.67	15.58±2.39	14.86±2.49
A1C (%)	5.538±1.534	5.983±2.057	5.652±1.885	5.386±2.198
A2C (%)	9.731±2.204	8.833±1.434	9.303±1.479	8.932±1.391
A1A2 (%)	62.73±23.26	70.58±27.96	64.56±22.85	64.29±26.34

between these comparison groups. The duration of the rheographic wave, the time of the descending part of the rheovasogram and the slow blood filling of the tibia vessels were significantly larger in volleyball players of intermediate somatotype compared to non-athletes girls of the same somatotype (in all cases $p<0.05$). In addition, there was a tendency of increasing the time of the ascending part of the rheographic wave and rapid blood filling in volleyball players of this constitutional type (Table 4).

It was established that the indicators of the ratio of the amplitude and time parameters of the tibia rheovasogram in volleyball players and girls of the control group with ecto-mesomorphic and intermediate somatotypes did not differ statistically significantly (Table 5).

But it should be noted that ecto-mesomorph volleyball players compared to non-athletes of the same somatotype had higher average statistical values of dicrotic index and diastolic index, indicators of the tone of large-diameter arteries and the ratio of arterial tones. And the tone index of all arteries, arteries of medium and small diameters, the average speeds of slow and fast blood filling in them were lower. In volleyball players with an intermediate somatotype, the large number of the integral indicators of the tibia rheovasogram were lower than in girls of the control group (Table 5).

DISCUSSION

Modern volleyball is one of the most popular sports both in Ukraine and in the world. During one game, each athlete performs a large number of technical tricks, about 200 jumps, a huge number of throws, high-speed movements on the sports field with a sharp change in direction, sudden stops and falls. During a volleyball game, the heart rate can increase to 200-220 beats per minute. Therefore, it is clear that modern volleyball makes high demands on the physical development of the volleyball player, his speed and strength training, and requires special endurance, which is limited by the state of the cardiovascular system [3, 19], in particular, central hemodynamics [5, 6, 20]. Studying a group of teenage volleyball players, Yu.I. Yakusheva [4] determined that their stroke and minute volumes, stroke index, volume spreed of blood movement and left ventricular power are significantly higher, and total peripheral resistance is significantly lower compared to girls of the same age who do not do sports.

The volume of blood flow in the arteries of the lower extremities is adjusted to the metabolic needs of the special muscles. In the studies of O.P. Khapitska et al. [8] were proved that sports specialization has influence to the peculiarities of muscle activity and led to marked differences in the parameters of peripheral hemodynamics between volleyball players, athletes, and wrestlers. In the group of young volleyball players, compared to athletes of the same age, the following rheovasographic indicators of the hip were significantly lower: the time of the descending part of the rheogram and the rheographic wave, while the time of the ascending part and slow blood filling of the rheovasogram, basic impedance, amplitude of the incision, and indicators of arterial tone were statistically significantly greater [7]. Indicators of local tibia blood flow also had a significant difference between young athletes of various sports. In particular, the time of the rheographic wave and the descending part of the rheogram was shorter in volleyball players compared to the athletes, and the amplitude parameters were larger: basic impedance, systolic wave amplitudes and rapid blood filling, the tone index of all arteries, the duration of the ascending part and slow blood filling of the tibia rheogram [8, 9].

Analyzing our results, it should be noted that in general group of volleyball players, compared to girls who did not play sports, is indicated higher amplitude and time rheovasographic indicators of the tibia. We found that the amplitude of the systolic wave, which indirectly indicates the functional state of the vessels and depends on a sufficiently large number of factors: heart rate, systolic blood volume, blood pressure and the tone of the vascular walls, was significantly higher in volleyball players compared to the control group [21].

Predominantly, when vascular tone increases, the amplitude of the systolic wave decreases, when vascular tone decreases - it increases. In addition, the amplitude of the diastolic wave, which reflects the ratio of arterial and venous blood flow, was also greater in volleyball players [22]. With the elasticity of arterial vessels, it is mainly a reflection wave

from the smallest arteries and arterioles. Since the degree of this reflection is functionally connected through the venular-arteriolar reflex with the state of venous full blood of the organ, it indirectly depends on the state of venous outflow [23]. The amplitude of rapid blood filling, which depends on the elasticity and tone of vascular walls [8, 21], is also higher in volleyball players.

Thus, it can be concluded that the amplitude parameters of the rheovasogram in volleyball players depend on many factors, in particular, on the work of the heart itself and the state of the vascular bed. In volleyball players, the state of capillary and venous blood supply of the tibia muscles is better compared to girls who do not play sports, but at the same time, they have a reduced tone of the arterial part of the vascular bed, which is confirmed by an increase in the amplitude indicators of the rheovasogram. Athletes who played volleyball showed a slight blood spreed, which is confirmed by their significantly higher values of the duration of the rheographic wave, the time of the ascending and descending parts of the rheogram, and slow blood filling. The time of the ascending part is the most stable indicator of the rheogram and does not depend on the heart rate, but reflects the period of complete opening of the vessel and provides clear information about the state of the vascular wall, because it depends on the tone of resistance vessels (arterioles and capillaries) [8, 23]. The time of the descending part depends, first of all, on the frequency of heart contractions, and its increase is also caused by a decrease in the elasticity of the vascular wall. The value of the time of slow blood filling is mainly determined by the tonic properties of the vascular wall of small and medium arteries. Therefore, based on the results of the analysis of the tibia indicators of the rheovasogram of the lower leg, it can be concluded that the elasticity of the vascular bed is somewhat reduced in volleyball players, which leads to the lengthening of the temporal characteristics of the rheovasogram.

At the same time, we did not find a reliable increase in arterial tone indicators in volleyball players. This can also be explained by the adaptive propeties of the female body, because all indicators of arterial tone, the time of slow blood filling and the ascending part of the rheovasogram of the lower leg tibia were statistically significantly higher in male representatives who were professionally involved in volleyball [7, 8, 9], and lower dicrotic index, time of the rheographic wave and the descending part of the rheogram compared to non-athletes.

The authors explain the detected changes with a pronounced slowing of blood flow in the tibia, a decrease in the elasticity of the vascular walls of arteries of medium and small diameters, high peripheral resistance, an increase in the tone of arteries of different diameters, which can have negative consequences for the health of athletes, because they can be signs of phlebopathy, which manifested by symptoms of venous stasis without revealing pronounced signs of organic pathology of the venous system [24].

The determination of individual indicators of the cardiovascular system by anthropo-somatotypological characteristics of the human body has been proven by many studies [14, 15, 16, 25, 26]. Indicators of regional blood flow of the lower extremities are related to the anatomical variability of the hip and lower leg in representatives of different sexes and body types [27]. We also discovered somatotypological features of rheovasographic indicators of the tibia in volleyball players. Within individual constitutional types, not all the differences we found between the general comparison groups in regional blood circulation indicators were preserved.

In particular, there was no significant difference between volleyball players and non-athletes with ecto-mesomorphic somatotype in the value of all rheovasographic parameters of the tibia; in volleyball players of mesomorphic somatotype, only 3 rheovasographic indicators were significantly higher than in girls who did not play sports of the same somatotype: the systolic wave amplitude, the time of the ascending part and slow blood filling. In volleyball players with an intermediate somatotype, the duration of the rheographic wave, the time of the descending part of the rheovasogram and slow blood filling of the tibia vessels were significantly higher.

The greatest differences in the indicators of tibia regional blood circulation were in representatives of the ectomorphic somatotype, who were characterized by significant longitudinal body dimensions and small muscle volumes and minimal development of subcutaneous fat deposits. In ectomorph volleyball players, compared to the control group, the amplitude of the systolic wave and rapid blood filling, the duration of the rheovasographic wave, the time of the descending part and slow blood filling of the leg rheovasogram were significantly higher than in control group.

In the studies of O.P. Khapitskaya found that the most prominent differences in the value of rheovasographic parameters are between young non-athletes and volleyball players with a mesomorphic somatotype [14].

That is why, the determination of the features of peripheral hemodynamic indicators of individual somatotypes in female volleyball athletes will enable a more correct determination of the reference values of rheovasographic parameters of the tibia and focus more attention of sports physicians during medical check-ups specifically on female athletes with an ectomorphic constitutional type, because they may have the highest risk of pre-existing conditions of venous circulation pathologies, because they may have the highest risk of pre-existing conditions of venous circulation pathologies.

CONCLUSIONS

1. In the general group of volleyball players, compared to non--athletes girls, higher amplitude and time rheovasographic indicators of the tibia were found. Significant differences between the comparison groups were determined for the amplitudes of the systolic and diastolic waves and rapid blood supply, the duration of the rheographic wave, the time of the ascending and descending parts of the rheogram and slow blood filling.
2. In volleyball players with a mesomorphic somatotype, the amplitude of the systolic wave, the time of the

ascending part of the rheovasogram and the slow blood filling of the tibia vessels were significantly greater than in to non-athletes girls of the same somatotype.
3. It was established that in volleyball players of ectomorphic constitutional type, the amplitude of the systolic wave and rapid blood filling, the duration of the reovasographic wave, the time of the descending part and slow blood filling of the tibia reovasogram were statistically significantly greater compared to the control group.
4. No significant difference was found in the value of all rheovasographic parameters of the tibia between volleyball players and non-athletes with ecto-mesomorphic somatotype.
5. In volleyball players with an intermediate somatotype, the duration of the rheographic wave, the time of the descending part of the rheovasogram, and the slow blood filling of the tibia vessels were significantly longer in time than in controls.
6. It was established that the ratio of amplitude and time parameters of the rheovasogram of the tibia does not reliably differ between volleyball players and non-athletes of general groups and within individual somatotypes.

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