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Functional conditions of the central blood-circulation of the weak-eyed children of senior preschool age.

The activity of the circulatory organs has its peculiarities at static loads. The heart rate doesn't change or slightly increases during the loads. Directly after the load the acceleration of the pulse is being observed. The minute blood volume insignificantly drops at static stress and somewhat increases after it .

In the beginning of the static load the grown organism responds by increasing of arterial tension: the systolic pressure increases at 30-50 mm Hg, and diastolic pressure increases at 20-30 mm Hg. The degree of the rise of arterial tension depends not so much upon the amount and mass of the muscles, engaged in the work, as on the value of the efforts. It is known, that the abrupt increase of tension of the small group of muscles can lead to the considerable rise of arterial pressure, rather than during the fulfillment of intense dynamic loads, in which all the muscles of the body take part.

The organism's demand of oxygen during the load is a clear index, which is being used for standardization of tests with physical load. The factor, providing the necessary oxygen demand, is the amount of cordial release. There is an instant dependence between the consumed oxygen and the amount of cordial release. The higher heart rate the examined person has during the load, the more oxygen is being consumed by the organism, and, accordingly, the physical work capacity is higher. The analysis of the central blood-circulation indices provides the information about the functional conditions of the cardiovascular system.

Isometric tension facilitates inadequate rise of arterial pressure, especially of diastolic pressure. The increasing of the "duple multiplication" (multiplication of the systolic pressure index and the index of the heart rate) indicates the myocardium's increased oxygen demand.

The reason of the abrupt rise of the blood pressure during static stresses is the irritation of the muscles' receptors. The uprising impulses proceed to the central nervous system and provoke pressor centers. The abrupt constriction of the arterioles facilitates the rise of blood pressure. After the termination of the stimulus action the impulse from the muscle receptors is being ceased and the arterial pressure comes to the initial value, or, sometimes even decreases. The tension, developed by the muscle, facilitates the constriction of the blood-vessels, located between the muscle fibers. All this prevents the deflux of venous blood and disfunction of excretion from the tissues. The constriction concerns also the arteries, as a result the muscles are not sufficiently provided with arterial blood.

The aim of our research was to study the peculiarities of the reaction of blood-circulation system of the five and six year's old children with vision disorders at the local static load.

The contingent of the examined persons and research technique.

The research work was conducted among 26 children, 12 of which were five year's old and 14 – six years old. As concerns the structure of the vision pathology, the children had refraction disorders (congenital hypermetropia, astigmatism, myopia), as well as amblyopia, congenital defect of visual nerve. The acuity of vision of the examined children didn't exceed 0.2 without vision correction.

The control group consisted of the children with acuity of vision from 1 to 0.9. As per the medical grounds, all children with normal vision had no serious deviations in the state of health and belonged to the basic medical group.

The static load was set with the help of oxygen dynamometer. During the load and after its termination within three minutes of relaxation period, the measurements of the heart rate and arterial pressure by the method of Korotkov, were conducted. Electrocardiograms were read off before and after the load. For the calculation of "duple multiplication" or Robinson's index (DM), which characterizes the level of myocardium's supply with oxygen, the following formula was used:

DM = APs x HR,

in which APs – the index of systolic arterial pressure (mm Hg), and HR - the index of heart rate (beats /per minute).

For evaluation of the minute blood volume (MBV) the Starr's calculations were used:

MBV = SBV x HR

In which SBV - the index of systolic blood volume, and HR - the index of heart rate (beats /per minute).

The index of the systolic blood volume (SBV) was calculated according to the formula, adapted for the children under the age of 15 years old, which is as follows:

SBV = (40+0.5 x PP-0.6 x APd) + 3.2 x A,

In which PP - the index of the pulse pressure (mm Hg), APd - the index of arterial diastolic pressure (mm Hg), A – age of the examined child. The pulse pressure (PP) is a difference between APs and APd.

The results of the research and their discussion.

The conducted research work confirmed, that the age evolution of the children with vision disorders has its distinctive features in contradiction to the children with normal vision.

So, according to our data, the Heart Rate of all the examined groups increases after local static load. The pulse indices of the 5 years old girls and boys with vision disorders in undisturbed state are higher, than of the 5 years old children with normal sight, while at the age of six the pulse indices come to the ones of the children with normal vision. The heart rate indices of the 5 years old boys and girls with vision disorders demonstrate the greater reaction to the static load, while at the age of six the greater gain of the heart rate of the children with normal sight is observed.

The value of systolic arterial pressure of all the examined children also tends to raise after static local load. The increase of the systolic arterial pressure value of the girls of both examined groups occurs less intensively, than, accordingly, of the boys. Weak-eyed boys demonstrate the greater reaction to static load, than the girls with vision disorders. With the increase of years the level of the expression of reaction of systolic arterial pressure comes down.

There are essential differences, which appeared from the side of arterial pressure at the stage of diastole in respond to the load in isometric regime among the weak-eyed children and the children with normal sight. At five the children with normal sight respond by the raise of the diastole arterial pressure indexes, while the children with vision disorders respond by its decrease. At the age of six the pressure impact of diastolic arterial pressure at load is observed among all the examined children.

The value of the index of systolic blood volume of the five year's old children was increasing after the local static load. There were more essential changes observed among the boys, than among the girls. The index of systolic blood volume of the children with vision defects appeared to be considerably higher at the expense of the raise of pulse pressure, than of the children with normal sight. At the age of six the systolic blood volume of all the examined children was decreasing, except the girls with normal sight, among which it almost didn't change. The value of the systolic blood volume was influenced by the indices of the pulse pressure, which were decreasing, except the girls with normal sight.

The indices of the cardiovascular system of the five and six years old children with normal sight and of the five and six years old children with visual deprivation.

indices	sex	age			
		5 years old		6 years old	
		I	II	I	II
Heart Rate, beats/minute	B	79,0±1,3 95,8 ±2,8	84,0 ±1,9 102,2± 2,3	85,3±2,4 92,4±2,9	96,0±5,4 94,8±1,7
	G	82,5±1,9 93,3±2,8	88,5 ±2,8 105,0±2,8	94,5±1,8 93,1±2,3	102,0±2,0 96,4±2,2
Systolic Arterial Pressure, mm. Hg	B	80,0±1,4 94,7±3,8	88,0±3,4 102,8±3,8	95,0±2,1 91,0±1,5	100,2±2,2 95,3±1,2
	G	88,7±2,4 98,6±2,0	93,8±2,4 104,0±2,4	98,2±2,1 99,0±2,3	102,0±1,9 102,7±2,4
Diastolic Arterial Pressure, mm. Hg	B	58,0±2,7 62,8±2,2	65,0±1,4 57,7±2,1	66,7 ±3,2 62,1±1,9	73,3±3,4 68,1±1,7
	G	59,5±2,9 56,4±1,7	61,2±3,0 51,5±1,1	62,8±1,5 61,0±1,6	64,3±1,8 65,8±1,8
Systolic blood volume, ml	B	32,2±1,2 34,3±1,2	38,5±1,6 43,9±1,4	33,4±1,4 36,0±1,2	28,7±1,7 32,0±1,3
	G	34,9±1,4 43,3±1,5	35,6±1,7 51,4±1,4	39,2±1,8 41,6±1,5	39,5±1,5 38,2±1,4
Minute blood volume, l/min	B	2,5±0,10 3,3±0,12	3,2±0,12 4,5±0,14	2,8±0,12 3,3±0,11	2,8±0,09 3,0±0,10
	G	2,9±0,14 4,0±0,12	3,2±0,11 5,4±0,13	3,7±0,10 3,7±0,12	4,0±0,12 3,7±0,11
Duple multiplication, (Robinson's index) stand. units	B	63,2 ± 1,2 90,7±1,3	73,9±1,4 105,1±1,2	81,0±1,4 84,0±1,3	96,2±1,2 90,3±1,4
	G	73,2±1,2 92,3±1,5	83,0±1,4 109,2±1,1	92,8±1,2 92,2±1,4	104,0±1,5 99,0±1,3

Comment: I – indices of cardiovascular system of the children without loading, II – indices of cardiovascular system of the children with loading; the first line across - the children with normal sight, the second one – the children with vision disorders.

The minute blood volume indices were increasing at a load among all the examined children of five years. The highest increase of indices, provided by the raise of heart rate and systolic blood volume, is observed among weak-eyed children. The minute blood volume index appeared to be higher among the weak-eyed girls, than among the weak-eyed boys. At local load the minute blood volume of the six years old children changed inconsiderably or stayed unchanged. Among five years old children the change of the minute blood volume value after static local tension was determined by the change of the systolic blood volume value, while at six it had a greater dependence upon the raise of the heart rate value.

The "duple multiplication" value is raising among all the examined children. Among five years old children the raise of this index is observed mostly among those, with vision disorders. As concerns six years old children - it is observed among the children with normal sight. This increase became lower among the children with vision disorders, in comparison with five years old kids. Thus, among the children with normal sight with the increase of years, the consumption of oxygen by myocardium at execution of local static load raises and the muscles' energy supply improves during the work. Conversely, among the children with vision disorders the decline of oxygen consumption by myocardium is observed, as well as decrease of energy product in the organism during the intensification of physiological processes.

Summary:

1. With the increase of age the oxygen consumption by myocardium decreases during the execution of local static load and the muscles' energy supply declines during the work among the children with vision disorders.
2. During the local static action with the capacity of 30% from the maximum there was the increase of heart rate and of systolic arterial pressure, and the decrease of the indices of diastolic arterial pressure among the five years old children with vision disorders. Among six-years old children the typical for the local static work reactions of the cardiovascular system are observed, which are characterized by the raise of heart rate, systolic arterial pressure and diastolic arterial pressure.
3. At five years the children with normal sight react by the raise of the indices of diastolic arterial pressure, while the children with vision disorders - by its decrease. At the age of six the pressure impact of diastolic arterial pressure at load is observed among all the examined children.