Effect of photochromotherapy on vascular endothelial function in patients with arterial hypertension

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The photochromothery influence on vascular endothelium function when hypertension

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RESUME

Here is described the photochromotherapy method for the treatment of patients with hypertension grade 2 and 3 at the age of 70 ± 2.5 years. The positive effect of the green light photochromotherapy on the vascular endothelium function at this pathology is shown.

Keywords: vascular endothelium, fotohromoterapiya, blood flow velocity, arterial hypertension.

SUMMARY

The article discusses the use of photochromotherapy in the treatment of patients aged 70 ± 2.5 years with arterial hypertension of 2 and 3 degrees. The positive effect of green light photochromotherapy on the function of the vascular endothelium in this pathology has been shown.

Key words: vascular endothelium, photochromotherapy, blood flow velocity, arterial hypertension.

Introduction

Arterial hypertension is one of the most important causes, first of all, of strokes, according to the frequency of which Russia is one of the first in the world. Currently, the object of attention of researchers has become the vascular endothelium, which is considered a target organ in arterial hypertension. It has been proven that the factors that improve endothelial function are exercise training, balneotherapy, angiotensin-converting enzyme inhibitors, which help to reduce cardiovascular complications. With external irradiation, energy is absorbed by cells, which leads to a change in the impulse activity of thermomechanically sensitive fibers, activation of segmental-reflex and local reactions of the microvasculature [1]. Established that green radiation is selectively absorbed by flavoproteins of the respiratory chain and protein complexes of calcium ions, changing the processes of cellular respiration in tissues [2]. In this regard, the methods of physiotherapy, which are based on the radiation of the optical range, are of interest.

The aim of this work was to study the effect of green light photochromotherapy onendothelial function in patients with arterial hypertension.

Materials and research methods

The study was carried out on the basis of the hospital of the Russian Academy of Sciences, St. Petersburg, on 39 patients aged 70 ± 2.5 years old, suffering from arterial hypertension of 2 and 3 degrees. From the general population, two groups were randomly formed: the main group (n = 20), whose patients underwent complex treatment in combination with the use of a course of photochromotherapy, and the control group (n = 19), where patients received only drug treatment according to the standard scheme. The average age of patients in the main group was 70.5 ± 1.8 years, and in the control group - 69.2 ± 2.5 years.

Photochromotherapy procedures were performed using the Spectrum-LC-02 apparatus (Fig. 1).

The impact was carried out on the reflex-segmental zone C4-Th4 with a wavelength of 540 nm (green light) in a course of 10 sessions, 5 minutes per 1 field.

The degree of endothelial dysfunction was determined by the method of ultrasound pulsed Doppler echographic examination of the brachial artery using an Ultramark 9 ultrasound scanner (linear transducer with a frequency of 7 MHz) with an assessment of endothelium-dependent vasodilation of the brachial artery during a cuff test with the calculation of changes in the velocity and diameter of the brachial artery. Endothelium-dependent vasodilation of the brachial artery was studied according to the method proposed by D. Celermajer [3]. The brachial artery was located 3–10 cm above the elbow bend. In the cuff for 5 minutes. created a pressure exceeding 50 mm Hg. Art. normal values, after which the pressure was removed. Diameter and blood flow velocity were measured immediately after the cuff was removed for five minutes at intervals of 30 seconds to 1 minute.

Before the start of measurements, the patient was at rest for 10–15 min. In total, 7 measurements were taken in each patient during one examination. An increase in the diameter of the brachial artery after 60–90 seconds against the background of reactive hyperemia by 10% or more was considered a normal reaction, a lesser degree was assessed as a pathological reaction. A decrease in the linear blood flow velocity was considered a positive result, as a consequence of an increase in the elasticity of the vascular wall.

Rice. 1. Apparatus physical therapy Spectrum LC-02. Oval marks the matrix of green LEDs, which was used in this work.

Results and its discussion

When blood enters the aorta during systole, part of the kinetic energy of the blood flow is spent directly on its movement through the vessels, part is converted into potential energy of the stretched vascular wall and part is dissipated to overcome the internal friction of the tissues of the vascular wall itself [4]. The elasticity of the vascular wall is understood as its ability to quickly return to its original state after the cessation of the deforming force. Pathological changes in the structure of the wall lead to a decrease in its elasticity, and as a consequence - to an increase in the speed of propagation of the pulse wave and blood flow during systole [4]. The more the vessel is stretchable, the lower the speed. Consequently, the linear blood flow velocity is one of the indicators of the functional state of the arterial system.

Further in table. Tables 1 and 2 show the results of measuring the diameter of the brachial artery for patients of both groups, as well as the reliability of intragroup differences before and after treatment, calculated using the Mann-Whitney test.

Table 1

Diameter of vessels in patients of the main group before and after treatment

Манжеточная проба, время	До лечения		После лечения		P
	Mean, mm	Std. error	Mean, mm	Std. error	
0	3,865	0,150311	4,01	0,165736	$P > 0,05$
30 сек.	3,97	0,186223	3,855	0,142252	$P > 0,05$
1 мин.	3,94	0,17051	3,815	0,141286	$P > 0,05$
2 мин.	3,925	0,174397	3,91	0,167631	$P > 0,05$
3 мин.	3,86	0,16502	3,98	0,161994	$P > 0,05$
4 мин.	3,835	0,131043	3,97	0,172459	$P > 0,05$
5 мин.	3,836842	0,121446	3,945	0,148231	$P > 0,05$

table 2

Diameter of vessels in patients of the control group before and after treatment

Манжеточная проба, время	До лечения		После лечения		P
	Mean, mm	Std. error	Mean, mm	Std. error	
0	4,075	0,16301	4,177778	0,174999	$P > 0,05$
30 сек.	4,18	0,15838	3,988889	0,176733	$P > 0,05$
1 мин.	4,07	0,14763	4,083333	0,170207	$P > 0,05$
2 мин.	4,205	0,184459	3,944444	0,176425	$P > 0,05$
3 мин.	4,185	0,137319	3,863889	0,120443	$P > 0,05$
4 мин.	4,07	0,142736	4,1	0,184001	$P > 0,05$
5 мин.	4,115	0,145688	4,144444	0,159087	$P > 0,05$

Table 3

Blood flow velocity in patients of the main group before and after treatment

Манжеточная проба, время	До лечения		После лечения		P
	Mean, mm/sec	Std. error	Mean, mm/sec	Std. error	
0	91,3	5,352864	74,1	3,783552	$P < 0,05$
30 сек.	91,95	5,755764	78,52632	6,025952	$P < 0,05$
1 мин.	90,95	4,946809	75,55	5,154188	$P < 0,05$
2 мин.	90,55	5,227697	75,95	5,12757	$P < 0,05$
3 мин.	89,85	5,401401	74,75	4,767696	$P < 0,05$
4 мин.	88,85	4,806397	75,8	4,591525	$P < 0,05$
5 мин.	88,94737	4,600708	75	4,568773	$P < 0,05$

As follows from the table. 1 and 2, neither in the main nor in the control groups there are no differences in the diameter of the vessels as a result of treatment, as well as there are no intergroup differences in this parameter (P> 0.05).

Table Figures 3 and 4 show the arterial blood flow velocities for both groups. The significance of intragroup differences before and after treatment was calculated using the Student's t test.

As you can see from the table. 3 and 4, as a result of treatment in the main group, the blood flow velocity significantly (P <0.05) decreased at all stages of the test, in the control group there were no significant differences.

Table 5 shows an intergroup comparison of changes in blood flow velocity as a result of treatment. Calculations were performed using Student's t test. There are significant differences at all stages of the test.

Table 4

Blood flow velocity in control patients before and after treatment

Манжеточная проба, время	До лечения		После лечения		P
	Mean, mm/sec	Std. error	Mean, mm/sec	Std. error	
0	92,9	5,384139	92,27778	4,92347	$P > 0,05$
30 сек.	97,6	5,356943	98,21053	5,171661	$P > 0,05$
1 мин.	96,45	5,149591	94,66667	4,75	$P > 0,05$
2 мин.	96	5,249561	96,88889	5,290816	$P > 0,05$
3 мин.	94,4	5,175549	96,5	4,687802	$P > 0,05$
4 мин.	94,65	5,465333	95,72222	4,701415	$P > 0,05$
5 мин.	92,05	5,372187	93,83333	4,37256	$P > 0,05$

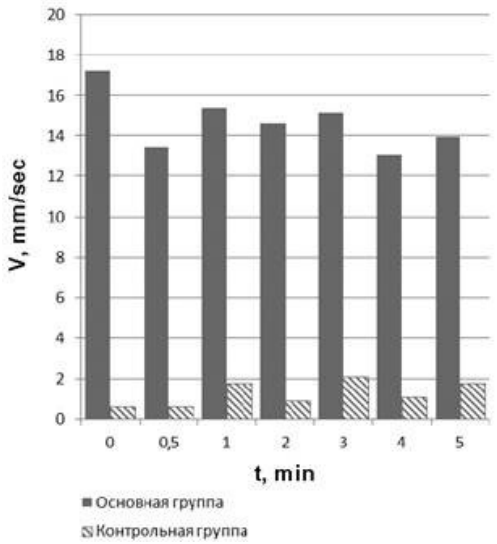
It follows from the results obtained that in patients of both groups, neither before nor after treatment, there were no significant changes in the diameter of the brachial artery. Apparently, this is a consequence of insufficient elasticity of the vascular wall due to atherosclerosis due to arterial hypertension.

As for the linear blood flow velocity, in the main group, it significantly (P <0.05) decreases on average by 20% compared to the initial state, while in the control group the differences are within the measurement error (Fig. 2). As noted above, this indicates an increase in the distensibility of the vessel as a result of treatment.

Table 5

Intergroup comparison of changes in blood flow rate as a result of treatment

Манжеточная проба, время	Основная группа		Контрольная группа		P
	Mean, mm/sec	Std. error	Mean, mm/sec	Std. error	
0	-18,7368	5,229718	-0,83333	4,361335	$P < 0,05$
30 сек.	-18,1667	5,960244	1,105263	2,495487	$P < 0,05$
1 мин.	-18,6842	5,118509	-3,16667	3,307992	$P < 0,05$
2 мин.	-17,6842	4,96423	-0,33333	3,985267	$P < 0,05$
3 мин.	-18,2632	5,486742	0,333333	4,267219	$P < 0,05$
4 мин.	-15,3684	4,907454	-1,16667	4,257443	$P < 0,05$
5 мин.	-15,8889	4,843896	-0,5	4,347075	$P < 0,05$



Rice. 2. Changes in the linear blood flow velocity as a result of treatment in the study and control groups.

Thus, despite the fact that it was not possible to register changes in the diameter of the brachial artery as a result of treatment, the fact of a decrease in the linear blood flow velocity indicates a systemic improvement in vascular endothelial function in patients of the main group.

Conclusions:

1. As follows from the data obtained, in both groups there are no differences in diameter. vessels as a result of treatment.

2. The linear velocity of blood flow in the brachial artery in patients of the main group is significant (P < 0.05) decreased on average by 18 mm / s at all stages of the test, in the control group there were no significant differences (1 mm / s).

3. Photochromotherapy with a wavelength of 540 nm has a positive effect on the endothelium vessels.

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