Color light therapy in the treatment of patients with arterial hypertension

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SUMMARY

Application incoherent optical radiation is an promising method non-drug treatment.

Purpose of the work: to review the literature on the clinical effects of the use of color light therapy in the treatment of hypertension. The search for publications was carried out in Russian and English in the eLibrary and PubMed databases for 1999–2019.

Conclusion: the use of color light therapy in blue (430–470 nm) and green (530–540 nm) has a significant effect on the pathogenetic links of arterial hypertension, normalizes systolic and diastolic blood pressure and can be used to treat hypertension of various origins.

Key words: color light therapy, arterial hypertension, "masked" arterialhypertension, hypertension "in the workplace", optical incoherent radiation of the visible range, LEDs, zones and points of the skin.

RESUME

Application of non-coherent optical emission is a perspective method of non-remedial therapy.

Aim of work: review of literature data on clinical application of color light therapy in treatment of arterial hypertension. Literature search was conducted in eLibrary and PubMed databases for articles published in Russian and English languages from 1999 to 2019.

Conclusion: application of color light therapy with blue (430–470 nm) and green (530–540 nm) color performs relevant effect on pathogenetic components of arterial hypertension, normalizes systolic and diastolic blood pressure and can be used in treatment of hypertensive heart disease of various genesis.

Keywords: color light therapy, arterial hypertension, "masked" hypertension, optical non-coherent light emission in visual range, light emitting diodes, zones and points of skin.

INTRODUCTION

Arterial hypertension is one of the most common chronic diseases of the cardiovascular system among the entire adult population and is about 30–45% [1]. If we talk about the Russian population, among men aged 25–65 years, this figure has a slightly increased value (in some regions it reaches 47%), while among women the prevalence of hypertension does not exceed 40% [2]. The incidence of arterial hypertension increases in direct proportion to age, reaching 60% or more in people over 60 years of age [1]. Taking into account the observed increase in life expectancy, accompanied by an aging population, which, in turn, increases the number of sedentary overweight patients, the prevalence of hypertension is predicted to increase worldwide. According to available forecasts, by 2025 the number of patients with arterial hypertension will increase by 15–20% and may reach almost 1.5 billion people [3]. Today, it is no longer in doubt that arterial hypertension is a leading risk factor for the development of cardiovascular (myocardial infarction, stroke, coronary heart disease, chronic heart failure), cerebrovascular (ischemic or hemorrhagic stroke, transient ischemic attack) and renal (chronic kidney disease) diseases [4–6] and, therefore, the main mechanism for the development of premature death of almost 10 million people and more than 200 million cases of disability in the world [4–6].

In the therapy and rehabilitation of patients with cardiovascular pathology, the use of physiotherapy methods, which, as a rule, do not have side effects, do not cause allergic reactions, and affect many pathogenetic links of the disease, have recently attracted great interest [7, 8]. Long-term studies of color light therapy as a method of treatment have shown the absence of non-therapeutic side effects, contraindications for use and high therapeutic efficiency.

Increasing the effectiveness of the treatment of arterial hypertension with color light therapy suggests

the need to take into account the reaction of the functional systems of the patient's body involved in the pathogenesis of the disease and the presence of concomitant diseases [9]. So, for example, the use of green color for the treatment promotes a pronounced decrease in blood pressure and is indicated for patients with arterial hypertension with concomitant hyperglycemia. Treatment in blue is focused on patients with arterial hypertension with impaired psychoemotional sphere and clinical manifestations of hypersympathicotonia.

METHODS

The review is based on publications in domestic and foreign press, available through Internet resources (eLibrary.ru, PubMed.com). The search was carried out from 1999 to July 2019. by keywords: color light therapy, optical incoherent radiation of the visible range, arterial hypertension, hypertension.

The publications on the results of research, available in full-text format, containing the results of treatment, correlated with the applied color effect, are accepted for consideration.

The use of color light therapy in the treatment of arterial hypertension

The results of the use of color light therapy in the treatment of arterial hypertension in combination with other methods, including medication, are shown in table. 1.

Table 1

Clinical Results of Color Light Therapy in the treatment of hypertension

No. p / p	Disease	Author (s)	Impact parameters (wavelength, nm; zone and exposure time)	results	Lite-ratura
1.	Arte-real hypertension	Alieva N.A., Osipova I.V., T.V. Kulishova	Blue (430 ± 30 nm) and green (530 ± 25 nm) color	Decrease in systolic blood pressure by 11.3%, and diastolic - by 7.2%. In the control group, the corresponding decrease was 9.8% and 6.4%.	[ten]
2.	Arte-real hypertension	Alieva N.A., Osipova I.V. Kulishova T.V., Zaltsman A.G., Dzhumigo M.A.	Blue (430-450 nm) and green (450-490 nm) color, irradiation of facial areas and front surface chest, 10 minutes for each color, 10 sessions 1 time per day daily	Minor increase blood pressure on a working day: systolic - by 10.5 ± 8.7 mm Hg. Art. and diastolic - by 7.4 ± 5.7 mm Hg. Art.	[eleven]
3.	Arte-real hypertension	Alieva N.A., Kulishova T.V., Osipova I.V., Dzhumigo M.A.	Blue and green color, course treatment	Decrease in growth blood pressure by 8.6% and 20.8% decrease in the proportion of people with high reactive anxiety	[12]
4.	Hypertension-cheskaya disease	Smirnova L.G., V.V. Achkasov	Blue light (470nm), internal irradiation sides of the elbow bend (over the vein), 10 minutes, 5 days in a row (two days off), 10 procedures	Reduction of blood pressure, improvement in accordance with the Kerdo index and endurance coefficient; no changes in the subjective state (health, appetite, mood, sleep, etc.), heart rate contractions, breathing and Hildebrant coefficient	[13]
5.	Arte-real hypertension	Goncharova I.A., A. V. Nikitin	Green light (530 nm), irradiation in contact for 90 s on points of the skin between the spinous processes	Decreased systolic and diastolic blood pressure, rapid normalization	[fourteen]

			WITHvii–Th1 and Th1–Th2, a point in the center of the heel, in the region of the crown of the head on distance 2 cm for 20 s, total time 6 min 20 s, 10-12 procedures 6 days a week, once a day	main clinical signs of illness, reducing the need patients in antihypertensive drugs and their single and daily doses	
6.	hypertension icy disease	Mashkovskaya Ya.N., Borovikova V.N., Novoseltsev S.V., Yesterday D.B.	Green light (540 nm) segmental zone WITH4–Th4, 5 min, 10 sessions	Improvement of patients' condition according to scales: physical functioning, role functioning, general health, social functioning. The greatest positive effect was exerted on role functioning, which due to emotional state and decrease depressive, anxious experiences	[15]
7.	Arte-real hypertension	Mashkovskaya Ya.N., Kiryanova V.V.	Green light (540 nm), segmental zone C4–Th4 two fields on the right and left for 5 minutes per field, 10 procedures	Maintaining content homocysteine at baseline	[16]
eight.	Arte-real hypertension essential naya	Volovnikova V.A., Shishkin A.N., Mashkovskaya Ya.N., Kiryanova V.V.	Green light (540 ± 20 nm), segmental zone WITH4–Th4, 5 min, 10 sessions	Decrease in systolic blood pressure, peripheral vascular resistance and a tendency to increase vegetative index	[twenty]
nine.	Arte-real hypertension	Mashkovskaya Ya.N., Udler Yu.S., Novoseltsev S.V., Yesterday D.B., Gvozdetskiy A.N.	Green light (540 nm), segmental zone C4–Th4 two fields on the right and left for 5 minutes per field, 10 procedures	Reduction of the linear blood flow velocity in the brachial artery by 20%, no effect on the diameter of the vessel	[21]
ten.	Arte-real hypertension	Volovnikova V.A., Mashkovskaya Ya.N., Shishkin A.N., Kiryanova V.V.	Green light (540 ± 20 nm), segmental zone WITH4–Th4, 5 min per one field, 10 sessions	Decrease in systolic blood pressure, increase in autonomic index, increase in blood flow rate from 1.09% to 6.7%	[22]
eleven.	Arte-real hypertension	Mashkovskaya Ya.N., Kiryanova V.V., Volovnikova V.A.	Green light (540 nm) segmental zone WITH4–Th4, 5 minutes per field, 10 treatments	Decrease in time-averaged blood flow velocity	[23]
12.	Arte-real hypertension	Volovnikova V.A., Mashkovskaya Ya.N., Kiryanova V.V.	Green light (540 nm) segmental zone WITH4–Th4, 5 minutes per field, 10 treatments	Decrease in time-averaged blood flow velocity, no effect on plasma homocysteine concentration	[24]

Currently, the problem of treatment of “masked” arterial hypertension, or hypertension “in the workplace”, which is observed in groups with a highly stressful profession, is becoming more and more urgent. This type of hypertension is characterized by higher blood pressure during working hours (stress response) than on weekends. It was found that men with high levels of stress in the workplace have an increased risk of developing myocardial infarction and stroke,

due to high blood pressure.

A series of studies is devoted to this problem, in which the effectiveness of the use of color light therapy in the treatment of workers of locomotive crews, who are a group at increased risk of developing arterial hypertension due to occupational stress, was studied [10–12].

Alieva N.A. et al. studied the use of color light therapy in the complex treatment of patients with grade I and II arterial hypertension in 34 men aged 24 to 54 years, who were divided into two equal groups - the main and the control [10]. Patients of both groups underwent complex drug treatment, and in the main group - additional color light therapy with blue (wavelength 430 ± 30 nm) and green (wavelength 530 ± 25 nm) colors using the apparatus "Chromogi" (Italy).

The results of therapy were assessed on the basis of indicators of general clinical examination, psychological status of patients (tests of SMOL, Spielberger-Khanin, SF-36), blood pressure, its daily monitoring and heart rate variability. As a result of the treatment, a positive dynamics of clinical symptoms was noted in both groups of patients with arterial hypertension, more pronounced in the main group against the background of a decrease in the number of complaints (headaches, dizziness), which either decreased or disappeared. There was a significant decrease in blood pressure in both groups, but the hypotensive effect was more pronounced in the main group, where color light therapy was used against the background of drug treatment. So, in the main group, a decrease in systolic blood pressure by 11.3%, and diastolic - by 7, was recorded. 2%, while in the control group the corresponding decrease was by 9.8% and 6.4%. There was a positive impact on the results of testing the psychological state of patients in the main group compared with the control. Thus, the changes found as a result of complex therapy with the inclusion of blue and green color therapy in patients with grade I – II arterial hypertension may indicate that the treatment has a positive effect on the clinical manifestations of the disease, significantly reduces blood pressure and improves psycho-emotional state.

Treatment of "masked" arterial hypertension as one of the variants of hypertension "in the workplace" requires certain specifics. In this case, in the course of treatment using color light therapy, a pathogenetic approach is required when choosing the applied color, which affects not only the cardiovascular system, but also the processes of inhibition and excitation in the cerebral cortex [11]. The treatment was carried out in 48 workers of locomotive crews aged 23 to 55 years with an increase in blood pressure> 140/90 mm Hg. during a pre-trip medical examination. An additional criterion for inclusion in the therapy group was the presence of a verified diagnosis of ischemic heart disease and hypertension of the III degree. Color therapy was carried out on the "Chromoj" apparatus in two colors - blue (wavelength - 430-450 nm) and green (wavelength - 450-490 nm), which irradiated zones on the face and anterior surface of the chest, each for 10 minutes, 10 sessions 1 time a day every day. After the course of color light therapy, the patients showed a slight increase in blood pressure on a working day: systolic - by 10.5 ± 8.7 mm Hg. Art., diastolic - by 7.4 ± 5.7 mm Hg. Art. There was also a decrease in emotional stress and anxiety, which was confirmed by psychological tests in 92% of patients after 10 sessions of color light therapy. Thus, the use of color light therapy in blue and green in the treatment of "masked" arterial hypertension relieves psycho-emotional stress,

In the next study, 98 men with stress-induced arterial hypertension (“in the workplace”) aged 24–54 years were observed [12]. All patients of the main group (48 people) and the comparison group (50 people) received complex physiotherapeutic treatment (massage, circular shower, magnetic therapy and physiotherapy exercises). Patients of the main group, in addition to complex treatment, underwent blue and green color therapy using the Chromojay apparatus. In both groups, blood pressure and heart rate were measured and tested according to Spielberger-Khanin and Luscher. According to the results of the survey, it was found that the inclusion of a course of color light therapy in the complex treatment allowed a statistically significant decrease in the increase in blood pressure by 8.6%, and by 20, Reduce the proportion of patients with high levels of reactive anxiety by 8%. The use of blue and green color therapy in complex treatment also significantly increased stress resistance and the quality of life of patients with arterial hypertension “at the workplace”.

The study of the possibility of using the methods of color light therapy in the complex rehabilitation of hypertensive patients of the older age group was carried out on 23 patients with hypertension II degree aged from 62 to 85 years (average age 73.5 ± 6.28 years) with an average duration of the disease 30.9 ± 3.71 years [9]. By the method of random sampling, two groups were formed - the main and the control, whose patients received a standard rehabilitation complex (physiotherapy exercises, massage, diet therapy, magnetotherapy). In the rehabilitation complex, patients are mainly

the group additionally included blue color therapy (wavelength 470 nm). The course of treatment consisted of 10 procedures, which were carried out in a sitting or lying position 30 minutes before the start of physiotherapy exercises every day for 5 days in a row (two days off). The inner side of the elbow bend (above the vein) was irradiated for 10 minutes using the GESKA-polycolour LED apparatus. During the entire observation period, patients of both groups underwent regular subjective and objective assessment of exercise tolerance, skin condition, hyperhidrosis, breathing pattern, and heart rate was measured. The preliminary results obtained allow us to conclude that a statistically significant decrease in blood pressure was revealed, as well as improvements in accordance with the Kerdo index and the coefficient of endurance in patients of the main group compared to the control group. At the same time, in patients of both groups, no significant differences were found in the subjective state (health, appetite, mood, sleep, etc.), as well as in the heart rate, respiration, and Hildebrant's coefficient. Thus, in accordance with the data obtained as a result of the conducted studies, it is possible to use color light therapy in the complex rehabilitation of hypertensive patients of the older age group. respiration and the Hildebrant coefficient. Thus, in accordance with the data obtained as a result of the conducted studies, it is possible to use color light therapy in the complex rehabilitation of hypertensive patients of the older age group. respiration and the Hildebrant coefficient. Thus, in accordance with the data obtained as a result of the conducted studies, it is possible to use color light therapy in the complex rehabilitation of hypertensive patients of the older age group.

The study of increasing the effectiveness of the treatment of arterial hypertension by including color light therapy in the complex traditional drug therapy (β-blockers, diuretics, etc.) was carried out on 70 patients (33 men and 37 women) with grade I – II hypertension [14]. Patients in the main group (48 people) were prescribed color therapy in addition to drug treatment, while in the control group (22 people), only drug therapy was used. Green therapy (wavelength 530 nm) was carried out using a Mustang-2000 LED apparatus in a pulsed mode with a pulse repetition rate of 1500 Hz. Irradiation was carried out by contact for 90 s along the points of the skin between the spinous processes C_{VII}–Th_1 and Th_1–Th_2, a point in the center of the heel and at a distance of 2 cm from a point in the region of the crown of the head for 20 s. The total exposure time was 6 min 20 s, 10–12 procedures daily, except Sunday, once a day (in the morning), at the same time ± 2 hours. Evaluation of the effectiveness of therapy in patients of both groups was carried out according to the dynamics of the levels of systolic and diastolic blood pressure and subjective clinical signs (headache, dizziness, autonomic syndrome, tinnitus, sleep disturbance, etc.). In assessing the quality of life, the SF36 questionnaire was used. Analysis of the research results showed that the inclusion of color light therapy in the complex treatment of patients with arterial hypertension according to the proposed method allows to achieve a reliable and significant decrease in the level of systolic and diastolic blood pressure and improve the quality of life of patients. The normalization of the main clinical signs of the disease as a result of the use of color light therapy occurred much faster, which also made it possible to reduce the need for patients in antihypertensive drugs and to reduce their single and daily doses.

Determination of the quality of life in patients with arterial hypertension of II and III degrees was carried out before and after the use of color light therapy in order to assess the effectiveness of this therapeutic method [15]. The studies involved two groups of patients: the main (47 people) with an average age of 71.3 ± 1.9 years and the control (24 people) - an average age of 68.7 ± 2.4 years with a disease duration for both groups 12 ± 3, 2 years. Patients in both groups received drug treatment according to the standard scheme, and in the main group, a course of color light therapy was additionally introduced. In the procedures, the Spectrum LC-02 apparatus was used, with the help of which the green color (wavelength 540 nm) was applied to the reflex-segmental zone C_4–Th_4 5 minutes per field in a course of 10 sessions. In assessing the quality of life of patients, the SF36 questionnaire was used on eight scales. Assessment of the general condition of patients in both groups, which was carried out before and after treatment, showed the presence of statistically significant differences between the main and control groups. In the main group, an improvement in the condition of patients was obtained according to the following scales: physical functioning, general health, social functioning, role functioning due to the emotional state, and a decrease in depressive, anxious experiences. In the control group, the patients showed a significant improvement only on the scale of the general state of health, and in some others (role functioning and depressive, anxious experiences) were not observed.

Determination of the dynamics of the level of plasma homocysteine as one of the risk factors for the development of cardiovascular diseases was carried out in patients with arterial hypertension to compare the effectiveness of two treatment regimens: drug therapy and a combination of drug therapy with color light therapy [16]. The study involved 115 patients: 31 men (27.0%) and 84 women (73.0%) with an established diagnosis of grade II – III arterial hypertension. All patients were divided into

two groups: the main group (65 people), in which drug treatment was carried out in combination with a course of color light therapy, and a comparison group (50 people), in which only standard drug treatment and a course of imitation color therapy were used. The average age of patients in the main group was 62.8 ± 1.7 years and 64.2 ± 2.6 years in the comparison group, with an average duration of the disease in the groups of 12.4 ± 1.3 years and 10.8 ± 1.5 years , respectively. Exposure to green color (wavelength 540 nm) on the reflex-segmental zone C_4–Th_4 (two fields on the right and on the left) for 5 minutes per one field, a total of 10 procedures were carried out using the apparatus "Spectrum LC-02". The blood homocysteine content of patients in the main group and the comparison group was determined before and after the course of treatment. The results of the performed analyzes showed that the use of color light therapy helps to maintain the homocysteine content at the initial level in the blood in patients with arterial hypertension against the background of ongoing drug therapy.

The results of experimental and clinical studies have led to the formation of knowledge about endothelial dysfunction, which is closely associated with diseases of the cardiovascular system. In the genesis of arterial hypertension, endothelial dysfunction is one of the universal mechanisms of vascular dysfunction [17–19]. An important aspect in the modern treatment of such a pathology is the correction and maintenance of adequate functioning of the vascular endothelium. Recently, it has been established that color light therapy is capable of influencing autonomic regulation, normalizing microcirculation, and stabilizing regional blood circulation by normalizing vascular tone and vascular blood filling.

In a series of studies, the effect of a course of green color therapy (wavelength - 540 nm) on endothelial function in patients with arterial hypertension was studied [20-24]. Color light therapy was carried out using the Spectrum LC-02 apparatus in green color (wavelength 540 ± 20 nm) with irradiation of the reflex-segmental zone C_4–Th_4 when exposed to two fields on the right and left for 5 minutes per one course of 10 procedures.

The possibility and effectiveness of using color light therapy in the treatment of patients with grade II and III essential arterial hypertension was studied in 115 patients (31 men, 84 women) with an average age of 57.5 ± 1.9 years without severe concomitant diseases [20]. All patients underwent drug treatment according to the standard scheme, in the main group (65 people) an additional course of color therapy was carried out, in the control group (50 people) - a course of imitation of color therapy. In addition to clinical examinations and laboratory tests, heart rate, autonomic index and peripheral vascular resistance were calculated in patients. When analyzing the results of the treatment, a statistically significant hypotensive effect was noted in both groups. Comparison of the dynamics of systolic blood pressure in the examined groups of patients showed a significant decrease in the main group of patients, while in the control group, the decrease in blood pressure was insignificant. The nature of the dynamics of the heart rate against the background of the treatment in patients of the main and control groups did not reveal significant changes in both groups. However, in the main group, there was a significant decrease in peripheral vascular resistance compared to the control group. Evaluation of the dynamics of the vegetative index during treatment did not reveal significant differences between the two groups of patients, however, there was a tendency to an increase in the value of this indicator in patients of the main group in comparison with the control group. High therapeutic efficiency of color light therapy,

The study was carried out on 39 patients with grade II and III arterial hypertension, from which two groups were formed: the main (20 people, average age 70.5 ± 1.8 years) and control (19 people, average age 69.2 ± 2 , 5 years) [21]. Determination of the degree of endothelial dysfunction was performed with a cuff test by pulsed Doppler sonography with an assessment of endothelium-dependent vasodilation of the brachial artery 3-4 cm above the elbow bend. The measurement of the vessel diameter and blood flow rate was carried out immediately after the removal of the cuff and then at intervals of 30 s to 1 min for five minutes. Comparative analysis of the results of measuring the diameter of the brachial artery in patients of the main and control groups before and after the course of treatment with color light therapy did not reveal significant differences in this indicator. However, the linear blood flow velocity in the brachial artery of patients of the main group as a result of the therapy significantly decreased by 20% at all stages of the test, while in the control group all changes were insignificant. Thus, the course of treatment with color light therapy led to a systemic improvement in vascular endothelial function, one of the evidence of which is an increase in vascular distensibility and a decrease in the linear blood flow velocity.

The effect of color light therapy on autonomic regulation and endothelial function was studied in 115 patients with an established diagnosis of grade II-III arterial hypertension, of which 31 were men (27%)

and 84 women (73.0%) [22]. Patients of the main group (65 people, mean age 62.8 ± 1.7 years) underwent drug therapy (β-blockers, diuretics, etc.) in combination with a course of color therapy, in the comparison group (50 people, mean age 64, 2 ± 2.6 years) - drug therapy in combination with imitation of exposure to color. The functional state of the endothelium of the brachial artery in patients was assessed by conducting a test of postocclusive reactive hyperemia using ultrasound color Doppler mapping. The values of the vegetative index for assessing the state of autonomic regulation in the cardiovascular system and peripheral resistance were obtained by calculation, based on the indicators of blood pressure (systolic and diastolic) and heart rate. Analysis of the treatment results showed a significant and more pronounced decrease in systolic pressure in patients of the main group and, to a lesser extent, in the comparison group, but without significant changes in diastolic pressure and heart rate. The dynamics of the vegetative index in both groups (main and comparison) as a result of treatment was characterized by a tendency to increase. The endothelial vascular function and the diameter of the brachial artery in patients as a result of treatment did not significantly change both in the main group and in the comparison group. In terms of blood flow velocity, a significant increase was noted as a result of treatment in patients of the main group from 1.09% to 6.7%. In the conclusion, based on the results of the studies carried out, it is noted that

The role of color light therapy in the treatment of patients with grade II – III arterial hypertension was analyzed based on the results of the functional state of the vascular endothelium, assessed by the diameter and volumetric blood flow rate [23, 24]. Patients with an average age of 57.5 ± 1.9 years by the method of continuous sampling were divided into two groups: the main (65 people) and control (50 people) groups with an average duration of the disease 12.4 ± 1.3 years and 10.8 ± 1.5 years, respectively. Assessment of the functional state of the endothelium of the brachial artery was carried out using a test with postocclusive reactive hyperemia and simultaneous measurement of the time-averaged blood flow velocity. In addition, the level of homocysteine in the blood plasma was determined in patients of both groups [24]. Preliminary examination showed that the majority of patients in the study and control groups had signs of endothelial dysfunction before treatment. The analysis of the dynamics of the increase in the diameter of the artery revealed no differences in the diameter of the vessels between the patients in the main and control groups, but a significant decrease in the blood flow velocity at all stages of the test was revealed, which, apparently, is associated with a decrease in the rigidity of the vascular wall as a result of treatment.

CONCLUSION

The use of color light therapy in blue (430–470 nm) and green (530–540 nm) in the complex treatment of arterial hypertension reliably reduces blood pressure, improves psycho-emotional state, increases stress resistance and quality of life of patients.

The results of studies of the effect of green color on the pathogenetic links of arterial hypertension indicate a significant decrease in peripheral vascular resistance and an improvement in endothelial function, as evidenced by an increase in vascular distensibility and a decrease in the linear blood flow velocity.

Light color therapy in blue and green can be used to treat hypertension of various origins.

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