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Analysis of the state of microcirculation in patients with generalized periodontitis with concomitant IHDCHI 2-3 FC by NYHA, against the backdrop of the use of the national drug "HANDELIA"

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Abstract: According to the incidence of periodontal disease, they occupy the second place after dental caries. We aimed to study microcirculation in generalized periodontitis with concomitant ischemic heart disease, chronic heart insufficiency 2-3 FC according to NYHA classification and assessing efficiency of national drug "HANDELIA". The principle of the method consists in probing the tissue with laser radiation, the treatment of the radiation reflected from the tissue is based on the detection of the detected signal of the Doppler shift of the reflected signal frequency, in proportion to the speed of the movement of red blood cells. In control group, 8 patients receiving only standard therapy for chronic heart failure (CHF). The observation group was individuals (n=12) with periodontitis combined with coronary heart disease (CHD) complicated by chronic heart failure (CHF) 2 and 3 by NYHA, standard therapy of CHF and a local ointment of domestic production "HANDELIA" containing a liquid extract of the capillary hair, lidocaine, menthol, sodium carboxymethylcellulose, glycerin was administered in complex treatment.Analyzing the M, IFM, and VT indices in aggregate, we note that patients have combination of spastic and stagnant forms of microcirculation disorders in the oral cavity. They have increased M (sign of hyperemia and congestion), reduced IFM (sign of spastic-atonic disorders) and increased VT (sign of spastic disorders). Against the background of treatment, M is restoreddisappearing congestion/stagnation; IFM tends to normalize (significantly increases with respect to pre-treatment, but still significantly below control), and VT remains without positive dynamics.

Kaywords: periodontitis; Laser Doppler Fluometry; chronic heart failure; ischemic heart disease; microcirculation; inflammation; vascular tone.

According to the incidence of periodontal disease, they occupy the second place after dental caries. The wide prevalence of the process, the progressing course, the ineffectiveness of dental treatment, singles out the problem of generalized periodontitis to the most urgent and important, having great social significance [7, 8, 9, 10].

It is known that the basis of periodontitis is the inflammation of the periodontal tissues. In this case, great importance in the development of which is attributed to periodontal inflammation, the leading links in the pathogenesis of which are disorders of microcirculation, accompanied by an increase in vascular-tissue permeability [3,7].

Laser Doppler Fluometry (LDF) is a noninvasive highly informative method for assessing the blood flow in the microcirculation system.

As is known microcirculatory bed is the smallest functional unit of the vascular system and includes arterioles, capillaries, venules, lymphatic capillaries.

Hemodynamics in the microcirculation system (MC) is determined both by internal circulation forces, and by the metabolic needs of the tissue. The most important factor in this case is a strict correspondence between the volume of the functioning vascular bed and the volume of circulating blood along it. The balance of oxygen delivery to tissues is provided under the condition of effective redistribution of blood flow in various parts of the tissue, which is achieved due to vasomotions - active rhythmic contractions of microvessel walls [1,2,6,11].

A fundamental feature of microcirculation is its constant variability, which manifests itself in spontaneous fluctuations in tissue blood flow. It is the variability of blood flow - there is an objective characteristic of the level of vital activity of tissues. Fluctuations in tissue perfusion (changes in vascular tone and blood flow) are controlled by active and passive mechanisms. Active mechanisms of microcirculation regulation include myogenic component (vasomotion), endothelial component (metabolic effects of nitric oxide, endothelin-1, etc.) and neurogenic influences (sympathetic and parasympathetic regulation). Passive mechanisms of modulation of MC include factors that cause fluctuations in blood flow outside the microcirculation system: the pulse wave from the arteries side (pulse fluctuations) and the sucking action from the veins (respiratory fluctuations). The influence of active and passive factors leads to a change in the blood flow velocity and the concentration of erythrocyte flow in the tissue [1,4].

The LDF method allows obtaining information on the value of tissue perfusion, on the state (safety) of the MC regulation mechanisms, allowing to determine the contribution of active and passive components to the overall mechanism of its regulation [3,5].

Materials and methods. Investigation of microcirculation was carried out with the help of the apparatus "LAKK-02" (Russia), in the laboratory at the center of dentistry and maxillofacial surgery of TGSI. The principle of the method consists in probing the tissue with laser radiation, the treatment of the radiation reflected from the tissue is based on the detection of the detected signal of the Doppler shift of the reflected signal frequency, in proportion to the speed of the movement of red blood cells. The result is recorded as a change in blood flow in the microcirculatory bed (fluorometry).

The study was performed before and 15 days after the treatment of periodontitis. The investigated surfaces were the marginal and alveolar surfaces of the gum and the zone of gingival attachment in the projection of the tips of the roots of the teeth. The LDF-gram was processed with the help of software: the calculation of the average perfusion value of tissues by blood - M, its "flax" - the mean square deviation of basal blood flow oscillations - RMS, blood flow variation coefficient - Cv, and the analysis of the amplitude-frequency spectrum of hemodynamic rhythms (low frequency - LF, very low frequency - VLF, high frequency - HF, pulse waves of floxosomias - CF) with the calculation of the index of floxosomias - IFM, the index of microvascular tone - CT, intravascular resistance index - R, blood shunting - PN, myogenic tonus index - MT and neurogenic tone - NT.

Groups of subjects: in control group persons aged 49.4 ± 1.2 years, receiving only standard therapy for chronic heart failure (CHF) (n = 8); the observation group was individuals aged 52.3 ± 0.9 years with periodontitis combined with coronary heart disease (CHD) complicated by chronic heart failure (CHF) 2 and 3 of the NYHA (New York Heart Association) functional class (FC) n = 12), standard therapy of CHF and a local ointment of domestic production "HANDELIA" containing a liquid extract of the capillary hair, lidocaine, menthol, sodium carboxymethylcellulose, glycerin was administered in complex treatment. The patients were applied to the gingival surface 2 times a day for 15 days.

RESULTS

The study of the basic parameters of the LDF-gram showed that in healthy subjects of the control group at the age of 49.4 ± 1.2 years, the microcirculation corresponds to the mesoemic type with an average level of tissue blood flow: the basal value of M tissue perfusion at the mean level, the MC is characterized by good variability RMS) and high ductility to regulatory influences (high Cv); the modulation efficiency is high (IFM is greater than 2).

In patients with periodontitis relative to the control group, there is a significant increase in basal blood flow (by 2.3 times), sharp fluctuations in blood flow (an increase in RMS of 1.9 times), an increased susceptibility to regulatory influences (1.3-fold increase in CB) and reliable a decrease in the effectiveness of regulatory influences (a decrease in the IMF is less than 1.5). Note that a high susceptibility against a background of low effectiveness of regulatory influences with an IFM of less than 1.5 allow us to conclude that there are persistent subcompensated changes in the periodontal hemodynamics of grade 2 (according to the classification of V.I.Kozlov et al., 2012). Against the backdrop of treatment, the level of basal blood flow and the degree of its variability under the action of modulations are restored, as evidenced by the parameters of M and RMS that do not differ significantly from those in the control group. The plasticity of perfusion to regulatory influences is restored, the integral indicator of the effectiveness of regulatory influences - the IFM also improves, but does not reach the level of control. According to V.I. Kozlov (2012), after the treatment in patients with periodontitis and ischemic heart disease with CHF 2-3 FC, there is a 1 degree (mild) of hemodynamic disorders (a decrease in blood flow of less than 10%), which are reversible (Table 1).

Table 1.

Parameters of LDF-gram in patients with periodontitis and ischemic heart disease with CHF FC 2-3 by NYHA

Examined group	M, пф.ед.	RMS, ф.ед.	Cv	IFM, ye
Controln=8	19,1±2,3	9,3±2,6	30,8±2,1	2,08±0,14
Patients with periodontitis and CHD CHF FK 2-3 before treatment , n=12	44,1± 3,1*	17,5± 1,0*	40,3±2,6*	1,45±0,12*
Patients with periodontitis and CHD CHF FK 2-3 after treatment , n=12	19,8± 2,6**	8,4±2,9**	26,3± 2,0**	1,77±0,07**
* - authentically concerning the control , p<0,05				
** - reliably relative to pre-treatment , p<0,05				

As can be seen from the foregoing, in patients with periodontitis and IHD with CHF FK 2-3 NYHA initially there are 2 degrees of microcirculation insufficiency, a spastic form, and after treatment. It was not possible to achieve full recovery of microcirculation in these patients, probably because of the presence of comorbidity in the form of IHD with CHF contributing to microcirculatory disturbances in all tissues, including parodontium tissues.

It was important for us to establish the state of active and passive mechanisms of modulation in patients with periodontitis with ischemic heart disease and CHF.

As is known, the MC channel is the connecting link between the arteries and veins, therefore, the rhythms of the fluctuations in the erythrocyte flow in tissues are influenced by both inflow pathways-active modulation and by the outflow pathways-passive modulations. According to the literature, the most significant in the diagnostic plan are the following waves of floxosomes:

LF (low) - low waves of flaxomotions in the frequency range 0.07-0.20 Hz (3-12 vibrations per minute) - characterize the blood flow that depends on the work of the vasomotors - smooth muscle cells in the precapillary part of the resistive vessels, refer to the active regulatory component.

HF (high) - fast waves of flaxomotions in the frequency range 0.20-0.40 Hz (12-24 vibrations per minute) are caused by the spreading of the bloodstream into the microvessels from the side of the outflow paths, characterize the outflow of blood due to the respiratory excursions (passive mechanism);

CF (cardio) - pulse waves of flaxomotions in the frequency range 0.80-1.50 Hz (50-90 vibrations per minute) - are caused by changes in the systolic and diastolic pressure (passive mechanism).

VLF (very low) - very slow waves of flaxomotions in the frequency range 0.01-0.03 Hz (1-2 oscillations per minute) - is caused by changes in the volume of endotheliocytes and characterize the state of humoral metabolic factors (active mechanism).

When studying the contribution of the frequency range to the power of the spectrum of the LDF-gram, it was found that in the healthy individuals of control

group-2 the active component: the modulation of VLF and LF, reflecting the state of the endothelium and the state of the muscle + neurogenic regulation component, makes the greatest contribution to the MT modulation, respectively. The passive effects of the pulse wave in the control group were 5.7 ± 0.6%, and respiratory fluctuations - less than 1% - 0.37 ± 0.05%. In patients with periodontitis with ischemic heart disease CHF 2-3 FK, the ratio of active and passive mechanisms of regulation is shifted somewhat towards a significant increase in the contribution of HF and CF. So, they have an increase in passive mechanisms of modulation of tissue blood flow with a certain decrease in active mechanisms: the proportion of HF increases by 1.7 times, and the share of CF - by 5.2 times with respect to control. Perhaps, these changes are caused by comorbidity - the presence of CHF. We believe that an increase in HF, reflecting an increase in the amplitude of the pulse wave, is associated with a decrease in the elasticity of the vascular wall in CHD CHF 2-3 FK, and an increase in CF is associated with a change in venous outflow with CHD with CHF (Table 2).

Table 2.

Spectral analysis of LDF-gram in patients with periodontitis and ischemic heart disease with CHF FC 2-3 by NYHA

Examined group	LF,%	HF,%	CF,%	VLF,%	CT	R
Control n=8	36,5±2,2	5,7±0,6	0,37±0,05	57,3±2,3	0,65±0,04	0,77±0,03
Patients with periodontitis and CHD CHF FC 2-3 before treatment , n=12	33,1±2,0	9,5±2,2*	1,92±0,60*	55,4±3,7	0,83±0,04*	0,92±0,09*
Patients with periodontitis and IHD CHF FC 2-3 after treatment , n=12	33,3±2,9	9,3±2,9	1,27±0,46*	56,0±5,8	0,84±0,04*	0,81±0,02

As can be seen from Table 2, the vascular tone (VT) in patients is significantly higher than in the control group, it does not change on the background of treatment, remains high. Intravascular resistance (R) in patients is also significantly higher than in control, but after treatment it is normalized, not significantly differing from the control index.

Interesting data were obtained by us regarding the dynamics of the index of intravascular resistance R. We identified 2 types of changes in patients: in 65% of patients, R was increased to 1.2-1.6; in 35% - reduced to 0.6-0.5 before treatment. After the therapy, R was reduced in those who had it initially elevated and increased in those patients who had been initially lowered. These data indicate a high plasticity of the mechanisms of regulation of microcirculation. It can also be noted that, in the treatment, positive shifts are noted in the parameter CF and R, while the remaining indices do not undergo changes. Perhaps it is the venules that are more responsive to therapy.

Analyzing the M, IFM, and VT indices in aggregate, we note that the patients

examined by us have a combination of spastic and stagnant forms of microcirculation disorders in the oral cavity. they have increased M (a sign of hyperemia and congestion), reduced IFM (a sign of spastic-atonic disorders) and increased VT (a sign of spastic disorders). Against the background of treatment, M is restored. disappearing congestion / stagnation; IFM tends to normalize (significantly increases with respect to pre-treatment, but still significantly below control), and VT remains without positive dynamics. This indicates the presence of spastic forms of microcirculation disorders in patients with periodontitis with CHD CHF even after treatment.

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