

## **Study of the relationship between periodontal diseases and the functional state of the vascular system in cardiovascular pathology**

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### **Abstract**

This article discusses the characteristic features of blood and saliva coagulation indices in patients with chronic generalized periodontitis and associated diseases of the cardiovascular system. The study material included 109 patients with the combined form of the disease. It was revealed that in patients with concomitant pathology, especially with concomitant pathology, structural hypercoagulation in saliva, while in the blood, there was an activation of the plasma link of the hemostasis system against the background of an increase in thrombin, which leads to an increase in blood soluble fibrin monomers.

**Keywords:** chronic generalized periodontitis, cardiovascular pathology, hemostasis system, saliva, blood

### **Introduction**

One of the important problems of dentistry is the study of the etiology and pathogenesis of chronic periodontal diseases, which often affects the state of the whole organism. The results of studies of the last two decades indicate significant clinical and pathogenetic relationships of periodontal diseases and internal organs. In the works of A.F. Eliseev (2013) it is indicated on a high degree of damage to periodontal tissues in patients with cardiovascular pathology. Therefore, today one of the topical issues is the question of the relationship of dental diseases with the pathology of the cardiovascular system. In chronic diseases of the periodontal tissues, persistent oral microflora can cause cardiovascular pathology indirectly through the epithelial cells of the oral mucosa. The latter indicates the need for an in-depth study of the cellular mechanisms of the immune-protective system of the oral cavity in the combined form of the disease, in particular, in patients with chronic generalized disease of periodontal tissues with a combined disease of the cardiovascular system.

Analysis of accumulated factors and observations leads to the understanding that the development of a generalized inflammatory process in the periodontium occurs against the background of complex disorders of homeostatic balance in the body. At the same time, large changes in the hemomicrocirculation of periodontal tissues in these patients were found. Taking into account the above, the purpose of this study was to study the relationship periodontal diseases and the functional state of the vascular system in cardiovascular pathology.

### **Material and research methods**

A total of 109 patients with chronic generalized periodontitis of moderate severity and associated diseases of the cardiovascular system (arterial hypertension, ischemic heart disease, angina pectoris II-IV functional class) aged 42 to 65 years were examined. The patients were divided into 3 groups, group I - 50 patients with chronic generalized periodontitis on the background of cardiovascular pathology. Group II - 34 patients with chronic generalized periodontitis on the background of cardiovascular pathology of combined adentia at the stages of treatment; Group III - 25 patients with periodontal pathology (CGP), without diseases of the cardiovascular system. He performed standard clinical, laboratory and dental examinations. It was mandatory for all study participants to read and sign an informed consent approved by the local ethics committee of the Ministry of Health of the Russian Federation. It should be noted that all patients included in the groups were examined by a cardiologist. A standard clinical dental examination was carried out: assessment of patient complaints, medical history and life, objective status, assessment of periodontal indices. The level of individual hygiene and the state of periodontal tissues were assessed in all patients. The hygienic state of the oral cavity was determined by the Green - Vermillion (OHI-S) method (Simplified Oral Hygiene Index). The depth of the periodontal pocket (PC) and the loss of the periodontal attachment (PZP) were measured. Gingival bleeding was assessed using the H.R. Muhleman. Tooth mobility was determined using the Miller scale (modified by T.J. Fleszar). To identify the developed forms of periodontal pathology used the periodontal index (PI, Rüssel, 1956); the degree of gingival recession according to P.D. Miller (1985). To determine the qualitative and quantitative composition of microorganisms in periodontal pockets, the method of polymerase chain reaction in "real time" was used. Blood and saliva were taken on an empty stomach for research. In saliva, prothrombin and thrombin time, activated partial thrombin time (APTT) and fibrinolytic activity were determined, and in blood, the content of fibrinogen and soluble fibrin-monomeric complexes (RFMK) was additionally assessed. All methods used are described in the manual for the study of the hemostasis system Barkagan ZS,

Momot A.P. (2001). The concentration of homocysteine and haptoglobin was determined by the enzyme-linked immunosorbent assay using HUMAN kits. Determination of the content of free hemoglobin as a marker of intravascular hemolysis in patients was carried out using the method recommended by V.I. Kozlovsky and A.V. Akulenok (2014). Statistical processing included the calculation of the parameters of mean values and their deviations, the significance of differences using Student's criteria. The significance of the differences was assumed according to the generally accepted requirements,  $p < 0.05$ .

### Research results and discussion

When analyzing the dental status of patients, more pronounced changes in the periodontal indices were found, which indicate inflammatory processes in the periodontium of patients of the first and second observation groups. The average value of the PMA index in the observation group was 63% (in the comparison group - 34%), the periodontal index Russel-PI =  $4.9 \pm 0.3$  (in the comparison group -  $1.4 \pm 0.1$ ). The PBI bleeding index in the observation group is almost three times higher than in the comparison group (3.1 and 1.1, respectively), although the mean values of the OHI-S hygiene index in patients of the observation group and the comparison group differ insignificantly: 2.5 and 2.3. The values of hygiene indices in the observation group were statistically significantly higher than in the comparison group, which indicated a deterioration in the state of oral hygiene. Based on the complaints identified, it should be assumed that the majority of patients with coronary heart disease have bleeding gums; they associate this with the intake of antiplatelet agents and anticoagulants, and not with unsatisfactory hygienic care. Analysis of the obtained research results showed that the majority of patients of group I complained of bleeding gums (spontaneous, when eating and brushing teeth) - 61%. In patients of group II, bleeding gums were observed only in 83%. Painful sensations when chewing food and brushing teeth were more often observed in patients of group II - 52%, in group II - 71%. No less characteristic complaint in generalized periodontitis is tooth mobility, so. Group I patients noted this symptom in 54% of cases, versus 71% of Group II patients.

Table 1

#### Patient complaints

	Group 1 Patients n=50	Group 2 patients n= 34	Comparison group n=25

Bleeding gums	31 (61%)	28 (83%)	6 (25%)
Painful sensations (when experiencing food, brushing teeth)	26 (52%)	24 (71%)	4 (17%)
Tooth mobility	27 (54%)	23(67%)	5 (18%)
Dry mouth	31 (62%)	27 (78%)	10 (39%)
Burning tongue	15 (29%)	12 (34%)	5 (18%)
Smell from the mouth	38 (76%)	28 (84%)	11 (42%)

Thus, all patients of groups I and II presented complaints due to structural and functional disorders of periodontal tissues. Investigation of periodontal pockets revealed that in patients of group I the average value of pocket depth was  $3.7 \pm 1.5$  mm. in patients of group II -  $4.1 \pm 0.3$ . To assess the state of the periodontium, the CPITN index was calculated. These tables show that more severe periodontal damage is observed in the second group than in the first group of patients, this is shown by high values of the CPITN index. Analysis of the OHI-S hygiene index (G&V) shows that higher values are noted in both the first and second groups. The PI index, which reflects the severity of periodontal lesions, in the first group is  $3.9 \pm 0.5$ , and in the second group,  $4.1 \pm 0.3$ . At the same time, the maximum value of the PI index was noted in CGP against the background of coronary artery disease with combined adentia. It is 4.1, which corresponds to a moderate-severe degree of chronic generalized periodontitis.

To determine the qualitative and quantitative composition of the microflora of periodontal pockets in the groups, five periodontal pathogens were studied: *A. actinomy-cetemcomitans*, *P. gingivalis*, *T. forsythensis*, *P. intermedia*, *T. denticola*, which are the most significant in the development of generalized periodontitis. The results of the analysis of microflora in the area of gingival pockets, carried out using PCR in "real time", are presented in the table.

Table 2

The frequency of detection of periodontal pathogens in different groups

	Group 1 Patients n=50	Group 2 patients n= 34	Comparison group n=25
A.actinomycetemcomitans	36 (71%)	27 (80%)	7 ( 28%)
P. gingivalis	38 (76%)	30 (89%)	7 ( 27%)
T. forsythensis	31 (61%)	22 (66%)	9 (36%)
T. denticola	29 (58%)	21 ( 61%)	8 (34%)
P. intermedia	27 (54%)	21 (62%)	7(28%)

Most often found in group II with combined pathology: DNA of Porphyromonasgingivalis (Pg) in 89% of people and DNA of Tannerellaforsythensis (Tf) in 66% of cases, DNA of Tannerellaintermedia in 62% of cases and DNA of Treponemadenticola in 71% of cases (table). In the control group the following prevailed: Least of all in the group with combined pathology of the cardiovascular system there was a periodontopathogen: Aggregatibacteractinomycetemcomitans (Aa) in 28%, and in the control group Prevotellaintermedia (Pi) in 28% of cases. Thus, it can be stated that all patients with cardiovascular pathology have one or another degree of bacterial damage to periodontal tissues, where Porphyromonasgingivalis and Aggregatibacteractinomycetemcomitans were more often observed in the first and second groups of patients.

In the studies of I.I. Chukuaev, (2007), it is indicated that P. gingivalis uses hemin (the breakdown product of hemoglobin) as food in the inflammatory exudate (periodontal fluid). To obtain hemin, the bacterium uses specific receptors of the outer membrane, proteases (gingipains) and lipoproteins. Therefore, the causative agent of gingivitis intensely destroys red blood cells and increases the amount of free hemoglobin in the blood. As can be seen from the presented research results (table 3), the level of haptoglobin in the blood has a peculiar dynamics. In the 1st group of patients, the haptoglobin index is 41.5% lower than the indicators of the comparison group, while in the patients of the 2nd group it did not decrease by 56% when compared with the indicators of the comparison group. Consequently, an increase in free hemoglobin in the blood activates the synthesis of haptoglobin by the liver for binding free hemoglobin in patients with a combined form of the disease and the formation of a haptoglobin / hemoglobin complex.

Table 3

The content of haptoglobin and the level of free hemoglobin in the blood in patients with CGP concomitant ischemic heart disease

	Group 1 Patients n=50	Group 2 patients n= 34	Comparison group n=25
Haptoglobin mg / dl	72,54±6.35*	54,38±4.17*	124.32±10.46
Free hemoglobin g / l	0,079±0,001*	1,06±0,09*	0,044±0,002

Note: \* - reliability of differences  $P < 0.05$  relative to the comparison group

It should be noted that each mechanical damage to the periodontal tissues with gingivitis leads to an increase in the formation of free hemoglobin, which is food for *P. gingivalis* and its reproduction. In turn, the local activation of this process leads not only to destruction and reparative processes in the periodontal tissues but also affects the coagulation system of both saliva and blood. In the case of ongoing tissue destruction or the presence of an infectious process, these endogenous toxins can persist for a long time in the body and cause a systemic and local inflammatory reaction in the cardiovascular system.

The observed increase in the concentration of free hemoglobin in the blood, against the background of a low level of haptoglobin, can adversely affect the functional state of platelets and, in turn, can contribute to the hemostatic system in this contingent of patients. As can be seen from the results of the studies presented in Table 4, we observed significant changes in the parameters of the hemostasis system in saliva in the examined patients. Thus, an increase in procoagulant and a decrease in fibrinolytic activity was revealed in saliva. The concentration of homocysteine in saliva in the examined patients was also increased.

The revealed hyperhomocysteinemia and an increase in procoagulant activity in saliva are a consequence of not only CGP, but also a violation of microcirculation, which creates a thrombogenic threat due to the involvement of endothelial cells of the oral mucosa in this process.

Table 4

Indicators of the hemostasis system and the level of homocysteine in saliva in patients with CGP concomitant ischemic heart disease

	Group 1 Patients n=50	Group 2 patients n= 34	Comparison group n=25
Prothrombin time,%	61,43±5,04*	60,12±5,21*	76,87±4,18

APTT,%	66,72±4,83*	60,34±6,04*	82,01±5,34
Thrombin time,%	61,54±4,67*	57,78±4,67*	81,56±5,53
Fibrinolysis,%	84,51±5,43	88,53±6,06*	74,83±4,28
Homocysteine, µmol / L	0,71±0,14*	0,83±0,15*	0,32±0,03

Note: \* - reliability of differences  $P < 0.05$  relative to the comparison group

Analysis of the hemostatic system and homocysteine parameters in the blood of the examined patients with CGP combined ischemic heart disease showed a state of hypercoagulability, as evidenced by a shortening of prothrombin time, APTT, thrombin time, an increase in the concentration of fibrinogen, an increase in fibrin-monomer complexes (RFMC), inhibition of fibrinolysis (Table 5). The concentration of homocysteine in the blood in patients of both groups was also increased in relation to the indicators of the comparison group by almost 1.5-2 times.

Thus, in patients with CGP combined with ischemic heart disease, especially in the group of patients with edentulous blood and saliva, a high procoagulant potential was noted against the background of inhibition of fibrinolysis and an increase in homocysteine concentration, which is apparently due to an increase in free hemoglobin, which activates the vascular-platelet link of the hemostasis system.

On the other hand, structural hypercoagulation observed in patients with impaired functional state of the cardiovascular system may be a risk factor for thrombotic complications. At the same time, against the background of the observed microcirculation disorders, trophic insufficiency in the periodontal tissues and destructive processes, a new recurrence of inflammation in the periodontal tissues may occur.

Table 5

Indicators of the blood coagulation system and homocysteine metabolism in patients with CGP concomitant ischemic heart disease

	Group 1 Patients n=50	Group 2 patients n= 34	Comparison group n=25

Prothrombin time,%	16,53±0,89*	16,21±1,02*	22,16±1,23
APTT, s	30,54±2,64*	28,97±2,36*	43,54±2,63
Thrombin time, s	16,11±0,87	16,0±0,63	19,54±1,18
Fibrinogen, g / l	4,83±0,37*	5,69±0,33*	3,31±0,24
RFMK, mg / 100 ml	7,91±0,56*	8,14±0,62*	3,43±0,28
Fibrinolysis, min	176,73±8,39	179,67±9,01	138,51±7,58
Homocysteine, µmol / L	14,52±1,32*	17,34±0,71*	8,19±0,72

Note: \* - reliability of differences  $P < 0.05$  relative to the comparison group

Thus, in the process of studying the dental status in patients with chronic inflammatory diseases of the periodontal tissues of concomitant cardiovascular pathology, the most informative hygienic and periodontal indices were established, the characteristic features of reactive glycoprotein and some indicators of the blood and saliva coagulation system were identified, which can be used as a control. for dental support of patients with coronary artery disease during dental implantation.

### Conclusions

1. It was revealed that each mechanical damage to the periodontal tissues during gingivitis leads to an increase in the formation of free hemoglobin against the background of P. Gingivalis toxins, which in turn can cause not only destructive and reparative processes in the periodontal tissues but also affect the cardiovascular system.

2. Revealed hyperhomocysteinemia and an increase in procoagulant activity in saliva are a consequence not only of CGP, but also a violation of microcirculation, in which a thrombogenic threat is created due to the involvement of endothelial cells of the oral mucosa in this process.

3. In patients with CGP combined with ischemic heart disease, especially in the group of patients with edentulous blood, a high procoagulant potential was noted against the background of inhibition of fibrinolysis and an increase in the concentration of homocysteine. the state of the endothelium of the vessels of the dentoalveolar and cardiovascular system.



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