

The influence of oral antimicrobial peptide content on the quantitative microflora composition in periodontal pockets among residents of a large industrial region

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of the article

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The aim was to study the influence of periodontal pocket microecology state on the local nonspecific resistance in steelworkers with generalized periodontitis.

Materials and methods. In total, 178 patients were examined. The study group consisted of 126 patients with generalized periodontitis of initial (n = 8), I (n = 32), II (n = 68) and III (n = 18) degree of severity, chronic course, exposed to work-related hazardous agents. The comparison group consisted of 32 patients with periodontitis of initial (n = 5), I (n = 10), II (n = 11) and III (n = 6) degree of severity without exposure to harmful conditions of steel industry. The control group included 20 otherwise healthy individuals. Detection of the main five periodontopathogenic microorganisms in the crevicular fluid was carried out by the polymerase chain reaction method. The levels of lactoferrin and cathelicidin LL-37 were measured by the enzyme-linked immunosorbent assay method.

Results. *Actinobacillus actinomycetemcomitans* and *Porphyromonas gingivalis* were less common, than other opportunistic bacteria in both study groups with initial severity of generalized periodontitis. With the disease development, there was a tendency to increase the number of positive samples for all microorganisms. A correlation was found between the microorganism presence in the sample and the severity of periodontal disease. In the patients of clinical groups, the concentration of cathelicidin LL-37 in the oral fluid was reduced. In the study group, a moderate inverse correlation between cathelicidin and *Porphyromonas gingivalis* as well as a weak inverse correlation between cathelicidin and *Prevotella intermedia* were revealed. Lactoferrin was correlated directly and moderately with *Porphyromonas gingivalis* and *Prevotella intermedia* but weakly – with *Treponema denticola*. In the comparison group, there were a statistically significant moderate inverse correlation between cathelicidin and *Porphyromonas gingivalis* as well as a direct correlation between lactoferrin and *Porphyromonas gingivalis*. Correlations between the concentrations of cathelicidin and lactoferrin in the oral fluid and other periodontopathogens were revealed to be weak.

Conclusions. The studies have shown significant disruptions of the oral cavity microecology in the patients exposed to harmful effects of steel industry. The correlation between the concentration of antimicrobial peptides and periodontal pathogens in the periodontal pockets has been found.

Ключові слова:

пародонтопатогенна мікрофлора, пародонтит, полімеразна ланцюгова реакція.

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Вплив антимікробних пептидів у ротовій порожнині на кількісний склад мікрофлори пародонтальних кишень жителів великого промислового регіону

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Мета роботи – дослідити залежність місцевої неспецифічної резистентності від стану мікроекології пародонтальних кишень у хворих на генералізований пародонтит, які працюють на сталепромисловому підприємстві.

Матеріали та методи. Обстежили 178 пацієнтів. Група дослідження – 126 хворих на генералізований пародонтит початкового (n = 8), I (n = 32), II (n = 68) і III (n = 18) ступенів тяжкості, хронічного перебігу, що ускладнені шкідливими чинниками виробництва. Група порівняння – 32 пацієнти з пародонтитом початкового (n = 5), I (n = 10), II (n = 11) і III (n = 6) ступенів тяжкості, які не працюють у шкідливих умовах сталепромиислового виробництва. Група контролю – 20 відносно здорових осіб. Основні п'ять пародонтопатогенних мікроорганізмів визначали методом полімеразної ланцюгової реакції. Визначення лактоферину та кателіцидину здійснили методом імуноферментного аналізу.

Результати. *Actinobacillus actinomycetemcomitans* і *Porphyromonas gingivalis* виявляли рідше за інші умовно-патогенні бактерії в обох групах хворих початкового ступеня тяжкості. З розвитком захворювання спостерігали тенденцію до збільшення кількості позитивних зразків усіх мікроорганізмів. Виявили кореляцію між наявністю у пробі мікроорганізму та ступенем тяжкості захворювань пародонта. У пацієнтів клінічних груп концентрація кателіцидину LL-37 у ротовій рідині знижена. У групі дослідження виявили зворотний кореляційний зв'язок помірної сили кателіцидину з *Porphyromonas gingivalis* і зворотний слабкий зв'язок кателіцидину з *Prevotella intermedia*. Лактоферин має прямий зв'язок середньої сили з *Porphyromonas gingivalis* і *Prevotella intermedia* та прямий слабкий зв'язок із *Treponema denticola*. У групі порівняння визначили статистично значущий зворотний кореляційний зв'язок середньої сили кателіцидину з *Porphyromonas gingivalis* і прямий зв'язок середньої сили лактоферину з *Porphyromonas gingivalis*. Виявили слабкої сили кореляційний зв'язок між концентрацією кателіцидину та лактоферину в ротовій рідині та інших пародонтопатогенів.

Висновки. Результати дослідження свідчать про істотні порушення мікроекології порожнини рота в пацієнтів, які зазнають впливу шкідливих чинників сталепромиислового виробництва. Встановили кореляційний зв'язок між концентрацією антимікробних пептидів і пародонтопатогенами пародонтальних кишень.

Влияние содержания антимикробных пептидов в ротовой полости на количественный состав микрофлоры пародонтальных карманов жителей крупного промышленного региона

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Цель работы – исследовать зависимость местной неспецифической резистентности от состояния микроэкологии пародонтальных карманов у больных генерализованным пародонтитом, работающих на сталепромышленном предприятии.

Материалы и методы. Обследовали 178 пациентов. Группу исследования составили 126 больных генерализованным пародонтитом начальной (n = 8), I (n = 32), II (n = 68) и III (n = 18) степеней тяжести, хронического течения, осложненные вредными факторами производства. Группа сравнения – 32 пациента с пародонтитом начальной (n = 5), I (n = 10), II (n = 11) и III (n = 6) степеней тяжести, которые не работают во вредных условиях сталепромышленного производства. Группу контроля составили 20 относительно здоровых лиц. Основные пять пародонтопатогенных микроорганизмов определяли методом полимеразной цепной реакции. Определение лактоферрина и кателицидина LL-37 провели методом иммуноферментного анализа.

Результаты. *Actinobacillus actinomycetemcomitans* и *Porphyromonas gingivalis* обнаруживали реже других условно-патогенных бактерий в обеих группах больных с начальной степенью тяжести. С развитием заболевания наблюдали тенденцию к увеличению числа положительных образцов по всем микроорганизмам. Установлена корреляция между наличием в пробе микроорганизма и степенью тяжести заболеваний пародонта. У пациентов клинических групп концентрация кателицидина LL-37 в ротовой жидкости снижена. В группе исследования отмечена обратная корреляционная связь умеренной силы кателицидина с *Porphyromonas gingivalis* и обратная слабая связь кателицидина с *Prevotella intermedia*. Лактоферрин имеет прямую связь средней силы с *Porphyromonas gingivalis* и *Prevotella intermedia* и прямую слабую связь с *Treponema denticola*. В группе сравнения установлена статистически значимая обратная корреляционная связь средней силы кателицидина с *Porphyromonas gingivalis* и прямая связь средней силы лактоферрина с *Porphyromonas gingivalis*. Отмечена слабой силы корреляционная связь между концентрацией кателицидина и лактоферрина в ротовой жидкости и остальных пародонтопатогенов.

Выводы. Результаты исследования свидетельствуют о значительных нарушениях микроэкологии полости рта у пациентов, работающих в условиях вредных факторов сталепромышленного производства. Установлена корреляционная связь между концентрацией антимикробных пептидов и пародонтопатогенами пародонтальных карманов.

Ключевые слова:

пародонто-патогенная микрофлора, пародонтит, полимеразная цепная реакция.

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The microbiota of the oral mucosa is resistant to environmental stresses, but its balancing abilities are far from unlimited. Moreover, harmful environmental influences cause a wide variety of clinical manifestations in periodontal inflammation [1,2].

Industrial workers, exposed to occupational hazards of varying origin, intensity and duration, are at high risk of all-cause and periodontal tissue morbidity in particular. Cause-effect relationship study on the occurrence and development of periodontal tissue diseases is a necessary prerequisite for optimizing the diagnostic, therapeutic, rehabilitation and preventive processes among workers engaged in industries, that is consistent with the current scientific trends and relevant to practical dentistry [3–6].

The species and quantitative composition of the oral microflora depends on many factors, as for example, genetic, alimentary, environmental, and functional. Although a number of factors influence the periodontal diseases, the microorganisms that form dental plaque are the main cause of periodontitis incidence and progression [7]. Periodontopathogenic bacteria including *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Tannerella forsythia* and *Treponema denticola* demonstrate high adhesive, invasive and toxic properties toward periodontal tissues [8].

Challenging cultural identification of a number of microorganisms is the main reason why bacteria in certain regions of the human body are understudied. Polymerase chain reaction (PCR), as a modern molecular biology method, is useful in resolving this problem. Due to its high sensitivity, PCR allows identifying even single bacterial cells in ideal conditions, enabling a species-specific detection of bacterial DNA fragment, and thus, bacterial strain typing and differentiating [9].

In periodontally healthy individuals, the relative detection rate of the five main types of periodontopathogens usually does not exceed 6 %. Pathological changes in periodontal tissues occur when marker bacteria penetrate the protective barriers of the macroorganism [10].

The oral cavity microflora and the interaction between local and general non-specific and specific resistance factors are the most informative indicators of periodontal tissue condition. Along with a number of protein factors of congenital immunity, such as complement system components, lysozyme, lactoferrin, cytokines, etc., endogenous antimicrobial peptides with endotoxin-neutralizing and immunomodulating activity play a special role in protecting the body against infections, providing the defense against a wide variety of microorganisms [11,12].

Indeed, the prognostic value of antimicrobial peptides determining in the oral fluid of patients exposed to harmful working conditions is not currently assessed.

Aim

The aim was to study the influence of periodontal pocket microecology state on the local nonspecific resistance in steelworkers with generalized periodontitis.

Materials and methods

In total, 178 patients without somatic pathology, aged between 21 and 50 years, were examined in the University Hospital Dental Center of Zaporizhzhia State Medical University. The work was organized in accordance with the provisions of the updated version of the Helsinki Declaration. All the patients were informed about the study objectives and methods in detail and agreed to participate.

The study group consisted of 126 patients with generalized periodontitis of initial (n = 8), I (n = 32), II (n = 68) and III (n = 18) degree of severity, chronic course, exposed to work-related hazardous agents. The comparison group consisted of 32 patients with periodontitis of initial (n = 5), I (n = 10), II (n = 11) and III (n = 6) degree of severity without exposure to harmful conditions of steel industry. The control group included 20 otherwise healthy individuals aged from 19 to 25 years without signs of periodontal diseases. Patients who received antibiotic therapy in the last 6 months were excluded from the study as being with affected microbiological profile and immune status. All the patients were examined clinically, laboratory and radiologically according to the Protocols on the provision of health-care services in the specialty "Therapeutic Dentistry", The Ministry of Healthcare of Ukraine, 2007.

A sample of periodontal pocket content was taken using a sterile paper endodontic pin (size No. 25), which was inserted with tweezers into the deepest site and held in place for 10 seconds. After sampling, it was placed in a sterile plastic Eppendorf tube (1.5 ml) containing 1 ml of physiological saline and stored frozen at -20 °C for no longer than two weeks. The samples were transported to the ZSMU Microbiological Laboratory in thermal containers with refrigerant.

A real-time polymerase chain reaction (PCR) method was used for the DNA detection of the main five periodontopathogenic microorganisms in the crevicular fluid using the reagent kit "ParodontoScreen" manufactured by SPA "DNA-Technology" LLC, RF. All the reactions were run on a CFX 96. To detect nucleic acids, the PROBE-NA-PLUS kit (SPA "DNA-Technology" LLC, RF) was used. Counts of *A. actinomycetemcomitans*, *P. gingivalis*, *P. intermedia*, *B. forsythus*, *T. denticola* in the crevicular fluid were expressed as Lg genome equivalent per sample (Lg GE/sample).

To study the levels of lactoferrin and cathelicidin LL-37, oral fluid samples were obtained from each subject by passive drool technique (spitting) into sterile tubes. Then the oral fluid was centrifuged at 8000 rpm for 15 minutes. A part of the supernatant was collected into plastic tubes and stored at -30 °C no longer than a month. The levels of lactoferrin in the oral fluid were measured quantitatively via an enzyme-linked immunosorbent assay (Immunochem Z 2100, USA) using a reagent kit "Lactoferrin-strip" (ng/ml, Vector-Best, Ukraine). The levels of cathelicidin LL-37 were determined by the enzyme-linked immunosorbent assay (Immunochem Z 2100, USA) using a reagent kit "LL-37, Human, ELISA" (ng/ml, Hycult Biotech Inc., Netherlands).

The obtained results were statistically analyzed using the Statistica 13.0 software, license No. JPBZ8041382130ARCN10-J. The normality of the data distribution was determined using the Shapiro–Wilk test. Most of the data were found to be non-normally distributed and expressed as Me ($Q_{25}; Q_{75}$) – median and interquartile range. Comparisons between two independent groups were done by non-parametric Mann–Whitney test, between four groups – by the Kruskal–Wallis test. To identify the relationship between the degree of the disease severity and the level of marker, a gamma correlation coefficient was calculated. The difference was considered statistically significant at $P < 0.05$.

Results

Analyzing the results of the microbiological periodontal pocket content examination among periodontitis patients in the study and comparison groups, we noted that almost all of them demonstrated changes in the periodontal pocket microbiota (Table 1).

A. actinomycetemcomitans and *P. gingivalis* were less common than other opportunistic bacteria in both study and comparison groups of patient with generalized periodontitis of initial severity. With the disease progression, there was an upward trend in the number of *A. actinomycetemcomitans* in both groups. *P. gingivalis* was identified in both groups among patients with II and III degree of periodontitis severity. The quantitative content of this strain in the study group was higher than that in the comparison group ($P < 0.05$).

The data obtained have shown the presence of periodontopathogenic bacterial species such as *T. denticola*, *P. intermedia*, *B. forsythus* in the disease, especially in II and III degree of severity, when a significant destruction of the alveolar bone had already occurred. However, the proportion of anaerobic microflora was higher in the study group patients ($P < 0.05$), (Table 1).

A. actinomycetemcomitans and *T. denticola* were revealed only in 5 % of the control group patients with an intact periodontium (20 people aged from 19 to 25 years). Bacteria *P. gingivalis*, *P. intermedia*, and *B. forsythus* were detected in none of the patients. The data presented can signify a "healthy" carriage of opportunistic microbes.

A correlation between the presence of a microorganism in the sample and the severity of generalized periodontitis has been found. A moderate correlation with *A. actinomycetemcomitans* has been revealed, especially in the comparison group. Similar results have been obtained for *P. gingivalis* showing a moderate correlation, which was stronger in the comparison group ($P < 0.05$). Although the *P. intermedia* count was moderately correlated with the degree of periodontitis severity in the study group, no correlation with this microorganism has been found in the comparison group. A moderate correlation has been detected with *T. denticola* in the comparison group, and a statistically significant weak direct correlation has been determined in the study group. No correlation has been found between the *B. forsythus* count and the severity of periodontitis ($P > 0.05$) either in the comparison group or in the study group.

Significant microbial contamination of the periodontal pockets in the study group patients in relation to the comparison group give us reason to believe that harmful industrial factors influence the development and course of periodontal diseases. In our opinion, occupational hazard factor exposures are responsible for dysfunction of various regulatory systems, impeding barrier properties in epithelium and inducing favorable conditions for a manifestation of oral microflora pathogenicity.

Occupational hazardous factors seriously influence the human homeostasis in flagrant violation of functions in the immune response. Antimicrobial peptides are essential components of local host immune response as able to regulate the course of inflammatory processes in the oral cavity and induce immunity.

Our previous studies have demonstrated the greater increase in oral fluid lactoferrin levels in the periodontitis

Table 1. Microflora of the periodontal pockets in patients based on the degree of chronic generalized periodontitis severity

Microorganisms, Lg GE/sample	Study groups	CGP severity Me (Q ₂₅ ; Q ₇₅)				Kruskal–Wallis test values	P Kruskal–Wallis	The gamma correlation coefficient between the level of microflora and the degree of disease
		initial	I degree	II degree	III degree			
<i>A. actinomyces-temcomitans</i>	Comparison group	0 (0; 0)	3.28 (2.99; 4.57)	3.75 (2.08; 4.37)	4.86 (3.82; 5.52)	H (3, n = 32) = 12,78	<0.01	0.474 (P < 0.05)
	Study group	0 (0; 0)	4.40 (0.00; 5,13)	3.38 (0.00; 4,57)	5.12 (4,51; 5,96)	H (3, n = 126) = 24.50	<0.001	0.302 (P < 0.05)
P Mann–Whitney at comparing groups		0.999	0.002	0,357	0,368			
<i>P. gingivalis</i>	Comparison group	0.00 (0.00; 0.27)	0.00 (0.00; 1.05)	5.37 (0.25; 5.86)	6.28 (5.54; 6.91)	H (3, n = 32) = 14.59	0.002	0.655 (P < 0.05)
	Study group	0.00 (0.00; 0.60)	0.00 (0.00; 1.26)	5.47 (0.93; 6.15)	5.72 (5.09; 6.27)	H (3, n= 126) = 26,66	<0.001	0.480 (P < 0.05)
P Mann–Whitney at comparing groups		0.942	0.918	0.755	0.271			
<i>P. intermedia</i>	Comparison group	0.73 (0.25; 4.07)	3.88 (2.20; 4.68)	4.86 (0.00; 5.13)	2.37 (0.00; 5.09)	H (3, n = 32) = 2.34	0.504	0.119 (P > 0.05)
	Study group	0.77 (0.00; 3.34)	2.03 (0.72; 4.46)	4.89 (3.52; 5.98)	5.72 (5.09; 6.27)	H (3, n = 126) = 18.19	<0.001	0.322 (P < 0.05)
P Mann–Whitney at comparing groups		0.826	0.281	0.524	0.194			
<i>T. denticola</i>	Comparison group	0.51 (0.00; 1.72)	3.92 (3.59; 4.52)	3.61 (0.53; 4.05)	5.23 (4.16; 5.30)	H (3, n = 32) = 14.10	0.003	0.398 (P < 0.05)
	Study group	1.58 (0.28; 3.87)	3.60 (1.42; 5.28)	4.09 (2.17; 5.14)	5.30 (4.19; 6.11)	H (3, n = 126) = 13.73	0.003	0.271 (P < 0.05)
P Mann–Whitney at comparing groups		0.421	0.323	0.113	0.405			
<i>B. forsythus</i>	Comparison group	2.95 (2.21; 3.55)	5.09 (4.93; 5.92)	5.18 (4.38; 5.41)	5.28 (3.45; 5.96)	H (3, n = 32) = 8.15	0.043	0.274 (P > 0.05)
	Study group	2.75 (2.28; 3.49)	5.42 (4.59; 6.15)	5.52 (5.06; 6.14)	5.58 (3.57; 6.09)	H (3, n = 126) = 13.68	0.003	0.173 (P < 0.05)
P Mann–Whitney at comparing groups		0.942	0.768	0.059	0.527			

Table 2. Oral fluid lactoferrin and cathelicidin levels (ng/ml) in the study group patients

Markers	Study groups	CGP severity Me (Q ₂₅ ; Q ₇₅)				Kruskal–Wallis test values	P Kruskal–Wallis	Gamma correlation coefficient between marker level and degree of disease
		initial	I degree	II degree	III degree			
Lactoferrin, ng/ml	Comparison group	11.34 (10.10; 12.19)	35.31 (28.68; 37.62)	50.59 (45.22; 58.34)	88.12 (86.69; 89.34)	H (3, n = 32) = 27.93	<0.0001	+0.989 (P < 0.05)
	Study group	14.15 (13.28; 15.66)	32.05 (28.67; 37.36)	74.89 (70.17; 80.25)	182.10 (158.61; 193.43)	H (3, n = 126) = 102.92	<0.001	+0.999 (P < 0.05)
P Mann–Whitney at comparing groups		0.067	0.478	<0,001	<0.001			
Cathelicidin, ng/ml	Comparison group	12.42 (12.22; 13.53)	3.43 (3.13; 3.72)	0.90 (0.76; 1.91)	0.28 (0.16; 0.58)	H (3, n = 32) = 28.31	<0.0001	-0.995 (P < 0.05)
	Study group	6.06 (5.17; 7.48)	2.60 (2.37; 3.51)	0.78 (0.71; 0.92)	0.29 (0.22; 0.57)	H (3, n = 126) = 101.46	<0.001	-0.991 (P < 0.05)
P Mann–Whitney at comparing groups		0.016	0.040	0.111	0.999			

patients exposed to occupational hazards as compared with that in the non-exposed patients ($P < 0.001$), (Table 2).

In the control group, the levels of lactoferrin were 16.87 (16.34; 17.51) ng/ml, cathelicidin – 107.59 (94.71; 122.67) ng/ml. Table 2 shows statistical differences in the indicators between the study groups and the control group (healthy individuals) ($P < 0.05$).

Bacterial factors result in increased oral epithelial barrier permeability in patients with periodontal diseases, triggering the local immune response. So, elevated levels of oral fluid lactoferrin in the patients can be considered as a compensation mechanism. The oral mucosal immunity activation was higher in the patients exposed to industrial harmful factors.

The oral fluid levels of cathelicidin LL-37 were reduced in the patients of clinical groups with periodontal tissue diseases. We have also noted a decrease in the local immunity with increasing periodontal disease severity, as evidenced by the decreased cathelicidin level as a non-specific factor of oral mucosa protection. Therefore, suppression of antimicrobial factors of innate immunity and cathelicidin LL-37 secretory reserves depletion in oral epithelial cells and neutrophils contributes to the development of oral cavity diseases.

A correlation analysis has been conducted between the lactoferrin and cathelicidin levels and microorganisms. Significant differences in the presence and strength of cor-

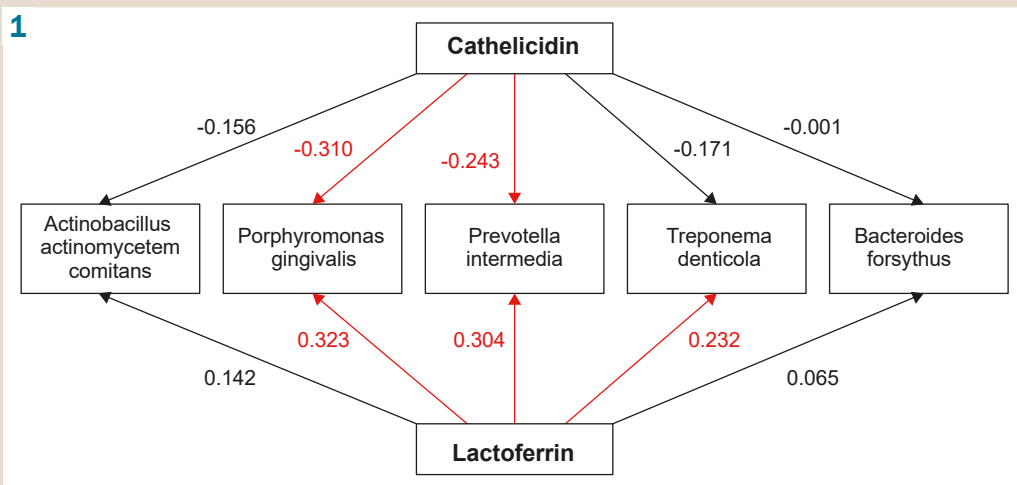


Fig. 1. Correlation between lactoferrin and cathelicidin levels and periodontal pathogens in the study group.

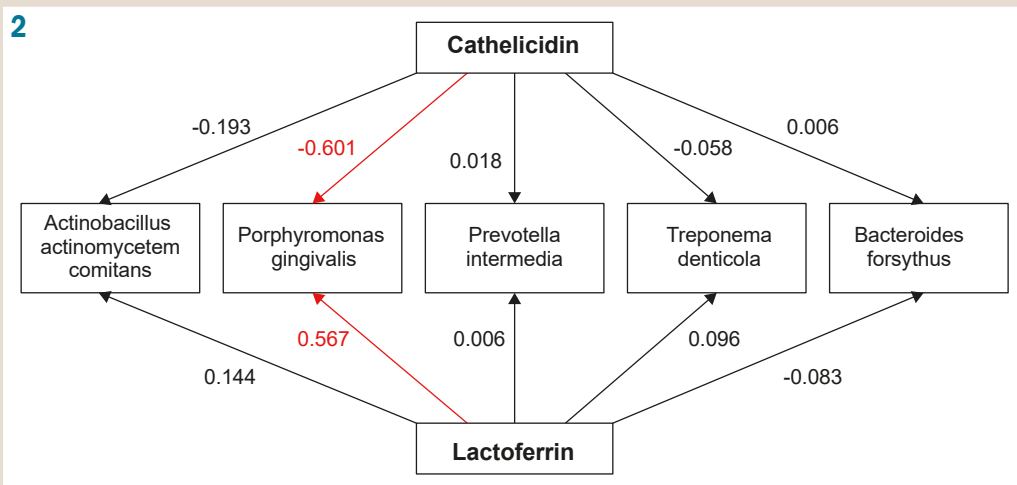


Fig. 2. Correlation between lactoferrin and cathelicidin levels and periodontal pathogens in the comparison group.

relations between the study and the comparison group have been found. For instance, in the study group, the cathelicidin levels demonstrated a moderate inverse correlation with *P. gingivalis* and a weak inverse correlation with *P. intermedia*. At the same time, lactoferrin showed a moderate direct correlation with *P. gingivalis* and *P. intermedia* and a weak direct correlation with *T. denticola* (Fig. 1).

P. gingivalis strains had a statistically significant moderate inverse correlation with the cathelicidin levels and a moderate direct correlation with the lactoferrin levels. The cathelicidin and lactoferrin concentrations in the oral fluid were weakly correlated with other periodontopathogens (Fig. 2).

Discussion

Our study results on the microorganism species composition of the periodontal pocket in the steel workers with generalized periodontitis are consistent with the literature data.

For one, although the published data on the frequency of microorganism detection in healthy individuals and in patients with generalized periodontitis vary considerably, an upward trend in the number of all microorganism samples was noted with the disease progression in most cases [12].

It can be explained as follows. The oral cavity is the first barrier to occupational hazard exposure, and this only reflects negatively on the periodontal pocket microbial communities. The influence of bacterial factors in patients with periodontal diseases increases the oral epithelial barrier permeability triggering the local immune response.

In the studies of Y. Yong and I. Birsan, all the marker microorganisms (*A. actinomycetemcomitans*, *P. gingivalis*, *P. intermedia*, *T. denticola*, *T. forsythia*) were identified in dental plaque and crevicular fluid samples using real-time PCR in patients diagnosed with periodontitis. It was noted, that the increase in the disease severity was accompanied by increased pathogenic periodontal microflora [13,14].

Kumawat R. M. et al. and Rafiei M. et al. reported that among the major periodontogenic pathogens in periodontitis, the main pathogenic agent in the development and progression of chronic inflammatory disease is *P. gingivalis*, which is present in both periodontal disease patients and in people with a healthy periodontium, though in a lesser extent [15,16]. The presence of *P. gingivalis* can be considered as the main potential risk factor for periodontitis, impairing host-microbe interaction and contributing to oral bacterial dysbiosis [17].

Our findings concerning the concentration of antimicrobial peptides are primarily due to their fundamental role

in the development of both cellular and humoral immune responses [18,19]. It is our opinion that namely the limited realization of the presented basic biological cathelicidin properties leads to the progression of periodontitis, since a decreased concentration of this peptide in the oral fluid results in its antibacterial properties reduction.

At the same time, an increase in lactoferrin concentration with the chronic generalized periodontitis progression was observed, which is another indication of the lactoferrin antimicrobial effect activation, associated with neutrophil recruitment in inflammatory reactions, mediation of bacterial cell phagocytic destruction and modulation of immune responses [20,21]. It is noteworthy that a variety of trends in the studied peptides may also indicate a weakening of the local immune response, despite the high lactoferrin concentrations in the patients with periodontal tissue diseases.

In this regard, the level of antimicrobial peptides is currently considered as a marker of the various inflammatory process activation. That should be borne in mind when developing new diagnostic and treatment approaches to the patients with periodontal diseases.

Conclusions

1. The studies have shown significant disruptions of the oral cavity microecology in the patients exposed to harmful effects of steel industry. The species of *P. gingivalis*, *P. intermedia*, *B. forsythus* were predominantly detected with periodontitis progress.

2. The pathological process activity was directly correlated with the oral fluid lactoferrin concentration and inversely – with the cathelicidin level.

3. The correlation between the concentration of antimicrobial peptides and periodontal pathogens in the periodontal pockets has been found.

Prospects of further research will focus on the development of treatment and prevention methods for periodontal diseases in residents of the large industrial region.

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