THE RESULTS OF THE INDEX COMPARATIVE EVALUATION OF PHOTODYNAMIC THERAPY AND ULTRAVIOLET IRRADIATION IN THE TREATMENT OF CHRONIC GINGIVITIS

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Abstract

In this clinical study, the effect of photodynamic therapy and ultraviolet radiation on the effectiveness of the treatment of periodontal diseases was examined according to the results of an index assessment. Clinical examination of 95 patients of both sexes aged from 18 to 32 years revealed chronic generalized catarrhal gingivitis (K05.1). The main index criteria for comparative parameters in all study groups were: simplified OHI-S hygiene index, Mullemann-Cowell bleeding index, PMA index. The indices were measured before and after treatment with subsequent control examinations in 1 month, 3 months, 6 months. The patients were divided into three groups and each group underwent standard periodontal treatment aimed at stopping the inflammatory process and preventing its further development. In the first group, the treatment was supplemented with the use of the FotoSan LED lamp with a wavelength of 630 nm, in the second the "Quasar" ultraviolet irradiator was used, in the third (control) group, the complex of therapeutic measures was carried out without physiotherapeutic procedures. According to the results of the study, the use of photodynamic therapy significantly accelerates the regenerative processes of periodontal epithelial tissue and reduces the number of treatment sessions.

Keywords: photodynamic therapy, ultraviolet irradiation, bleeding, gingivitis, hygiene index.

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РЕЗУЛЬТАТЫ ИНДЕКСНОЙ СРАВНИТЕЛЬНОЙ ОЦЕНКИ ПРИМЕНЕНИЯ ФОТОДИНАМИЧЕСКОЙ ТЕРАПИИ И УЛЬТРАФИОЛЕТОВОГО ОБЛУЧЕНИЯ ПРИ ЛЕЧЕНИИ ХРОНИЧЕСКОГО ГИНГИВИТА

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Резюме

В клиническом исследовании рассмотрено влияние фотодинамической терапии и ультрафиолетового облучения на эффективность лечения заболеваний пародонта по результатам индексной оценки. В результате клинического осмотра у 95 пациентов обоих полов в возрасте от 18 до 32 лет был выявлен хронический генерализованный катаральный гингивит (К05.1). Основными индексными критериями сравнительных параметров во всех группах исследования являлись: упрощенный индекс гигиены по OHI-S, индекс кровоточивости по Мюллеману-Коуэллу, индекс PMA. Показатели измерялись до и после лечения с последующими контрольными осмотрами через 1 мес, 3 мес, 6 мес. Пациенты были разделены на три группы, в каждой группе проводилось стандартное пародонтологическое лечение, направленное на купирование воспалительного процесса и предупреждение дальнейшего его развития. В первой группе лечение дополнялось использованием светодиодной лампы FotoSan с длиной волны 630 нм, во второй группе применялся ультрафиолетовый облучатель «Квазар», в третьей (контрольной) группе комплекс лечебных мероприятий проводился без физиотерапевтических процедур. По результатам исследования применение фотодинамической терапии значительно ускоряет регенераторные процессы эпителиальной ткани пародонта и сокращает количество сеансов лечения.

Ключевые слова: фотодинамическая терапия, ультрафиолетовое облучение, кровоточивость, гингивит, индекс гигиены.

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Introduction

The state of health of organs and tissues of the oral cavity has a great influence on the quality of life and well-being of a person [1].

Periodontal diseases are a serious public health problem affecting more than half of the adult population worldwide [2], and have not only medical but also social significance due to the high incidence, great variety and severity of the course [3]. The presence of chronic infection foci in the human body can cause the development of a large number of diseases and negatively affect the state of the dental system [4].

Gingivitis is an inflammatory process of the gum mucosa caused by the presence of a bacterial biofilm. The main clinical manifestations of gingivitis are gingival redness, bleeding [5] and edema [6].

In the treatment of periodontal diseases, physiotherapeutic methods have found wide application [7].

Photodynamic therapy (PDT) is based on the use of photosensitizers and light of a certain wavelength [8]. Photosensitizers are activated by low-intensity laser radiation with a wavelength corresponding to the absorption peak of the photosensitizer [9]. The photosensitizer toluidine blue can selectively accumulate inside the mitochondria of bacterial cells and causes a significant reduction in the number of cariogenic species. Toluidine blue can easily penetrate the bacterial membrane, has a transmembrane permeability coefficient higher than other photosensitizers, has low toxicity to human cells, a high rate of generation of reactive oxygen species and versatility due to a wide absorption band, which allows it to be activated using many light sources [10]. As a result of the photochemical reaction, negatively charged radicals are released, which have a pronounced bactericidal activity, stimulating tissue proliferation and regeneration [11].

Ultraviolet radiation is a spectrum of electromagnetic vibrations in the range from 180 to 400 nm. In terms of its activity, it significantly exceeds all other parts of the light spectrum, but, given the smallest depth of penetration into tissues – only up to 1 mm, their direct effect is limited to the surface layers of the irradiated areas of the skin and mucous membranes. Ultraviolet radiation increases the activity of protective mechanisms, has a desensitizing effect, normalizes blood coagulation processes, and improves lipid metabolism [12].

The aim of this study was to study the effectiveness of combined treatment of periodontal diseases, including standard therapy with the additional use of photodynamic therapy or ultraviolet irradiation.

Materials and methods

The study involved 95 patients of both sexes diagnosed with chronic generalized catarrhal gingivitis (K05.1). The diagnosis was made on the basis of the clinical picture and panoramic x-ray data and clarified in accordance with the classification of periodontal diseases adopted at a meeting of the presidium of the periodontology section of the Russian Academy of Dentistry in 2001.

The study was approved by the local ethics committee of the Federal State Budgetary Institution of Higher Education I. N. Ulianov Chuvash State University and was carried out in accordance with the principles of the Declaration of Helsinki of the World Association "Ethical principles for conducting scientific medical research involving humans" (as amended by the 64th WMA General Assembly, Fortaleza, Brazil, October 2013).

Criteria for inclusion in the research work were: availability of informed voluntary consent to participate in a clinical trial; age of patients from 18 to 32 years; absence of chronic somatic diseases and aggravated allergic anamnesis; the presence of hyperemia and bleeding gums.

Exclusion criteria: benign and malignant neoplasms; acute and chronic infectious and viral diseases; 2 and 3 degrees hypertension; pregnancy and lactation; somatic diseases in the acute stage; systemic blood diseases; hypersensitivity to ultraviolet radiation and intolerance to the components of the photosensitizer.

In the study groups, an objective examination revealed the presence of a burdened local dental status: dental plaque (biofilm) and mineralized dental deposits.

The complex of periodontal treatment in all groups consisted of the following stages: professional hygiene followed by coating of the teeth with a fluorine-containing agent, the appointment of local anti-inflammatory and antiseptic therapy.

All patients were informed about the need to comply with the terms of attendance at all stages of treatment. During the general clinical examination, the anamnesis, complaints (bleeding, pain in inflamed gums, hyperemia of the gingival margin) and objective data were taken into account. During the study, the main criteria for comparative parameters in all study groups before and after the start of treatment were: hygiene index (HI) according to OHI-S (Green, Vermillion, 1964), bleeding index according to Muhlemann-Cowell (Muhlemann-Cowell; 1975), PMA index (C. Parma, 1960). The terms of control visits with the measurement of indicators were 1 month, 3 months, 6 months.

The patients were divided into three groups. The first group consisted of 32 (33.7%) patients, the second – 31 (32.6%), the third (control group) – 32 (33.7%) patients. Participants of all groups underwent professional oral hygiene with controlled brushing. Patients were taught the basic rules of oral care, and they were also given a selection of items and hygiene products. At home, the study participants used toothpaste based on herbal extracts (sage, echinacea, myrrh, chamomile, ratanya and mint) (GlascoSmithKline Healthcare JSC, Russia), sodium bicarbonate and sodium fluoride (1400

ppm), alcohol-free rinse based on an aqueous solution of chlorhexidine digluconate (0.2%) and sodium fluoride (250 ppm).

To conduct PDT in the first group, the photosensitizer toluidine blue was used at a concentration of 1 mg/ml. Irradiation was carried out using a FotoSan 630 LED lamp with a wavelength of 620-640 nm for 10 seconds on the area of each tooth with an inflamed gum area. The treatment included 3 courses of PDT, the interval between courses was 4 days.

In the second group, ultraviolet radiation was used with the Kvazar device through a tube in the spectral range from 205 to 315 nm, each quadrant of the upper and lower jaws was irradiated in turn. Duration of exposure: 1/2 biodoses for each area with a gradual increase to 2 biodoses. The treatment course included 10 procedures.

The treatment tactics of participants in the third control group did not include physiotherapeutic methods of influence.

All participants were taken for dispensary registration with the registration of periodontal parameters.

When analyzing statistical indicators, the program "Statistica 6.0" was used. In evaluating the results, the data of the mean and its standard deviation (M±m) were taken into account. The parameters compared in the groups were evaluated using the Mann-Whitney U-test. At $p<0.05$, the differences were considered statistically significant.

Результаты

In the course of a clinical study, during the initial examination, the presence of soft and hard dental deposits was determined in all 95 patients, hyperemia and swelling in the area of the gingival papillae and marginal gums were found in 78 (82.1%), signs of congestive hyperemia (cyanotic coloration) – in 17 (26.15%), gum bleeding – in 82 (86.31%) patients.

Signs of destruction of the interalveolar septa on orthopantomographies in patients of all observation groups were not detected.

Prior to the start of treatment, in all groups, IG indicators were at the same level and corresponded to indicators of poor hygiene (see Table 1). After professional hygiene, teaching the rules of brushing teeth and individual selection of items and hygiene products, the index score improved in most of the subjects throughout the course of treatment.

At the initial examination (see Table 2), the data of the periodontal PMA index in all groups corresponded to the average degree of inflammation. The indicators after 1 and 3 months in all experimental groups were minimal, and the differences between them were not statistically significant. After 6 months, in the second and control groups, an increase in the index was noted compared to the first group, that is, in patients treated with PDT, a more stable remission was obtained.

The bleeding index (see Table 3) at the initial visual examination in all compared groups indicated an average degree of inflammation, which indicates bleeding of the gingival sulcus and gingival hyperemia. Evaluation of the bleeding index after 1 month showed a decrease in its value in all study groups. After 3 months, the bleeding index values were higher compared to the previous values in all three observation groups. How-

Таблица 1
Динамика показателя индекса гигиены
Table 1
Dynamics of the hygiene index

Обследуемые группы Study groups	Индекс гигиены (M ± m) Hygiene index (M ± SE)			
	До лечения Before treatment	После лечения After treatment		
		1 мес 1 month	3 мес 3 months	6 мес 6 months
1 группа – ФДТ Group I – PDT	2,69±0,08	0,42±0,02*	1,04±0,09**	1,36±0,06**
2 группа – УФО Group II – UVI	2,71±0,08	0,49±0,02*	1,28±0,06**	1,52±0,07
Контрольная группа Control group	2,64±0,07	0,55±0,03	1,42±0,07	1,59±0,08

Примечание: * – статистически значимая достоверная разница по сравнению со значениями до лечения ($p<0,05$); ** – статистически значимая достоверная разница показателей по сравнению с контрольной группой в этот же период наблюдения ($p<0,05$).
Note: * – statistically significant difference compared to the values before treatment ($p<0.05$); ** – statistically significant difference compared to the control group during the same observation period ($p<0.05$).

ever, compared with the control, statistically significant lower index values were recorded in groups in which physiotherapy was additionally used. After 6 months of follow-up, significant differences persisted only in the PDT group.

A dynamic evaluation of the effectiveness of periodontal treatment revealed that in the first group after PDT using the FotoSan LED lamp, 2 (6.25%) patients complained of bleeding after brushing their teeth throughout the entire course of treatment, HI remained unsatisfactory (1.7), the index bleeding corresponded to 0.5, PMA – 27%.

There were complaints of bleeding after brushing the teeth during the entire course of treatment in 6 (19.3%) patients who received Ultraviolet irradiation sessions. HI remained unsatisfactory (1.8), bleeding index was 0.8, PMA – 35%.

In the control group, the persistence of complaints

Таблица 2
Динамика показателя пародонтологического индекса
Table 2
Dynamics of periodontal index

Обследуемые группы Study groups	Индекс PMA (M ± m) PMA index (M ± SE)			
	До лечения Before treatment	После лечения After treatment		
		1 мес 1 month	3 мес 3 months	6 мес 6 months
1 группа – ФДТ Group I – PDT	51,27±2,12	10,69±0,51*	14,54±0,7**	18,54±0,89**
2 группа – УФО Group II – UVI	55,04±2,25	13,12±0,61*	15,97±0,71**	27,73±1,29
Контрольная группа Control group	53,69±2,21	13,81±0,65	17,5±0,81	28,42±1,33

Примечание: * – статистически значимая достоверная разница по сравнению со значениями до лечения (p<0,05); ** – статистически значимая достоверная разница показателей по сравнению с контрольной группой в этот же период наблюдения (p<0,05).
Note: * – statistically significant difference compared to the values before treatment (p<0.05); ** – statistically significant difference compared to the control group during the same observation period (p<0.05).

Таблица 3
Динамика показателя индекса кровоточивости
Table 3
Dynamics of the bleeding index

Обследуемые группы Study groups	Индекс кровоточивости (M ± m) Bleeding index (M ± SE)			
	До лечения Before treatment	После лечения After treatment		
		1 мес 1 month	3 мес 3 months	6 мес 6 months
1 группа – ФДТ Group I – PDT	1,82±0,03	0,16±0,075*	0,30±0,013**	0,37±0,05**
2 группа – УФО Group II – UVI	1,86±0,03	0,25±0,01*	0,45±0,02**	0,60±0,06
Контрольная группа Control group	1,84±0,03	0,28±0,012	0,53±0,026	0,64±0,06

Примечание: * – статистически значимая достоверная разница по сравнению со значениями до лечения (p<0,05); ** – статистически значимая достоверная разница показателей по сравнению с контрольной группой в этот же период наблюдения (p<0,05).
Note: * – statistically significant difference compared to the values before treatment (p<0.05); ** – statistically significant difference compared to the control group during the same observation period (p<0.05).

of bleeding after brushing the teeth during the entire course of treatment was noted in 9 (28.1%) patients. HI remained unsatisfactory (1.8), bleeding index was 1.2, PMA – 40%.

Dispensary follow-up of the study participants for 12 months revealed a more stable remission and improved diagnostic criteria in patients who received additional PDT treatment (see Fig.). The index of HI in the group became satisfactory, but changed insignificantly.

In the second and control groups, an increase in HI was observed, which indicated an unsatisfactory result of treatment. The bleeding index showed a mild degree of inflammation in all groups. The values of the PMA index in patients of the second and control groups corresponded to the average degree of inflammation, in the group with the use of PDT, a slight increase in the index was noted.

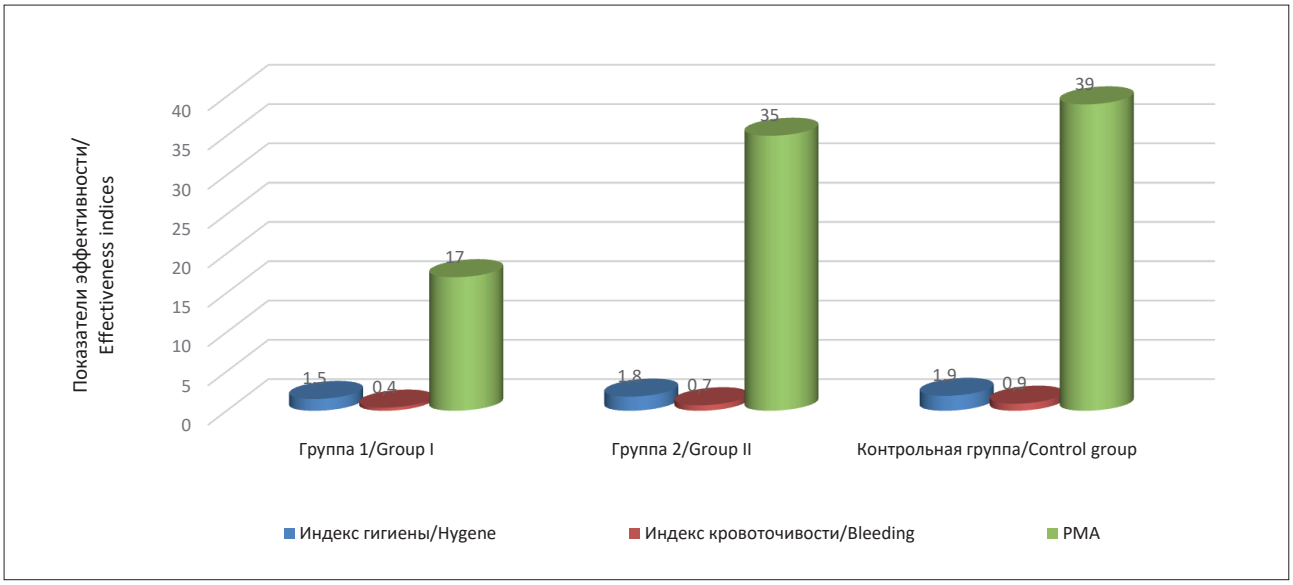

Рис. Показатели индексной сравнительной оценки эффективности лечения хронического гингивита через 12 мес.
Fig. Comparative assessment of the effectiveness indices of chronic gingivitis treatment after 12 months.

Discussion

The results of this study highlight the importance of developing preventive and therapeutic measures aimed at preventing the progression of periodontal disease.

In particular, chronic generalized catarrhal gingivitis can lead to periodontitis, which causes resorption of the alveolar bone and subsequent loss of teeth, and can exacerbate the risk of developing various systemic diseases such as diabetes, rheumatoid arthritis, and inflammatory diseases of the gastrointestinal tract [13].

During the examination of the oral cavity, the dentist can obtain information about the severity of the disease using index indicators [14]. Clinical indices used in the research part of the work assess the condition of the periodontium, objectifying information about the clinical picture in the mouth and the level of hygiene care.

According to the primary examination in patients of all groups, the presence of soft and hard dental deposits was determined. To improve the hygienic condition and reduce the periodontopathogenic microflora, professional controlled hygiene and the selection of oral cavity care items and products were carried out, as a result of which the clinical indicators of the periodontium improved.

In the practice of providing dental care, the importance of restorative and rehabilitation technologies has increased significantly, among which physical methods play a leading role. Physical factors, having an immunocorrective and healing effect, affect the body as a whole, change the physicochemical properties of cells and the metabolic processes occurring in them at the cellular level [15].

The results of the study showed that patients who, in addition to the main one, received physiotherapeutic treatment in the form of PDT or ultraviolet irradiation, showed better dynamics of recovery compared to the control group. Comparison of the two physiotherapeutic methods showed significantly better index values for PDT local impact on inflammation foci both after the end of therapeutic measures and during follow-up monitoring.

Currently, many researchers are turning to studying the possibilities of PDT, which is widely used in various fields of medicine [16, 17].

Conclusion

According to the results of the index evaluation in the treatment of chronic generalized catarrhal gingivitis, the therapeutic effect of PDT was more effective than ultraviolet irradiation.

The use of PDT is an effective non-invasive additional treatment for patients with periodontal diseases, it contributes to a more rapid decrease in the inflammatory process and prolongs the period of disease remission.

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