Dental Status and Specific Immunity of the Oral Cavity in Adolescents Living In Ecologically Unfavorable Areas

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Abstract – The paper presents the results of a study of the effect of ecotoxicanst on the state of dental status and local immunity in the oral cavity in 100 adolescents (14–16 years old) permanently residing in the Industrial District of the city in whose territory there are enterprises of heavy metallurgy. The control group consisted of 44 adolescents of the same age, from an environmentally friendly area. Hygienic indices, the state of hard tissues of teeth and periodontal, the presence of dentofacial anomalies were investigated. To determine the level of resistant activity of the oral cavity, the content of immunoglobulin A (IgA) of blood and secretory immunoglobulin A (sIgA) saliva were determined in 37 in the main and 44 adolescents of the control group. According to the data obtained, adolescents exposed to environmental stress revealed an unsatisfactory level of oral hygiene, increased dental morbidity and changes in the content of secretory immunoglobulin. According to the study, the average sIgA levels in adolescents with periodontal pathology from an environmentally unfavorable area corresponded to the lower limit of reference values and were significantly reduced relative to its elevated values in inflammatory periodontal diseases in the control group.

Key words – adolescents, metallurgical production, oral cavity diseases, immunological parameters.

I. INTRODUCTION

According to most researchers, exogenous pollutants in the form of heavy metal vapors, sulfur dioxide and other toxic environmental factors can have a significant negative impact on human health. It is believed that the contribution of environmental factors to the health of the population living in this territory is about 40% [1–4]. However, environmentally determined pathological changes in health status, as a rule, do not have specific nosological forms [5, 6]. A significant impact on the state of human health, and on the dental status, has a rapid deterioration of the ecological situation.

According to numerous researchers, one of the indicators of the ecological state is soil. At the disposal of "FederalPress" there are results of laboratory studies of the soil of Vladikavkaz in the areas adjacent to "Electrozinc". The depth of the fence did not exceed 0.2 m. In the conclusion issued by LLC Center for Expertise and Research of St. Petersburg, the results of the analysis are presented. According to the laboratory conclusion, only one out of 12 samples corresponds to the “dangerous” category of pollution, all the rest are classified as “extremely dangerous”. Permissible lead content is exceeded 125.5 times. Cadmium – 51.87 times, arsenic – 6.61 times, zinc – 6.32 times, copper – 2.91 times. The first three inorganic substances belong to the first class of danger, and copper and zinc – to the second.

Concentration in the city of Vladikavkaz of unhealthy enterprises of non-ferrous metallurgy and processing industry, a significant number of units of vehicles, together with a low degree of air flow through the territory, lead to increased environmental tensions and a significant increase in the incidence of the population. An increase in incidence rates leads to several important social and medical problems.

Over the past decade, studies have been carried out aimed at clarifying the mechanisms of the impact of heavy metals in the industrial zone on the health of the population living in the immediate vicinity of the Electro Zinc metallurgical plant.

Research R.V. Zoloev, studying the prevalence of dental diseases among workers of the Electro Zinc plant, conducted in...
1997, revealed a high level of pathology of both hard-dental tissues and periodontal tissue [7].

It is known that the predictor of the development of oral diseases in most cases is a decrease in the resistance of local immunity, the main indicator of which is the level of sIgA.

The formation of innate immunity, able to respond to the presence of pathogenic environmental factors, occurs in childhood to 7–8 years. The impact of ecotoxins in an environmentally unfavorable area is accompanied by their accumulation in the body, and the physiological features of the oral cavity (variety of functions, abundant vascularization and innervation) determine the role of the oral organs as the primary barrier to reacting to negative environmental effects. At the same time, ecotoxins influence the state of the local immunity system, the important components of which are lysozyme, lactoferrin, sIgA and others [8–10].

Despite the considerable interest in the problem, so far, the assessment of the pathogenetic effect of environmental environmental toxicants on the development of diseases of the dental-maxillary system has not been given enough attention, which served as the basis for research.

II. THE PURPOSE OF THE STUDY

The purpose of the study is to clarify the dental status of adolescents 14–16 permanently residing in the ecologically unfavorable region of Vladikavkaz and to assess the contribution of factors of specific immunity of the oral cavity, especially the pathological processes.

III. MATERIALS AND METHODS

A. Study Participants

In the course of the work, adolescents aged 14–16 years old, 48 boys and 52 girls permanently residing and attending schools in the area of the Electrozin plant, were examined.

The control group is represented by 44 adolescents of the same age (21 boys and 23 girls) permanently living and studying in an environmentally safe area of the republic (Digora). The criterion for inclusion in the research was the absence of a general somatic pathology, manifestations of which could be changes in the dental status. In accordance with the requirements of the Committee on Biomedical Ethics, the survey was conducted with the written consent of the parents.

B. Research stages

Studies were conducted in 2 stages.

At the first stage, a visual and instrumental examination of the oral cavity was performed on the basis of the SOGMA dental clinic, respectively, a WHO map for assessing dental status (1997), including the definition of hygienic indices: the hygiene index Fedorova Yu.A., Volodkina VV; UIG – simplified hygiene index, Greene-Wermillion; assessment of the state of hard tissues of teeth (KPU index) and periodontal (gingival index GL, CPITN index); the presence of dental anomalies.

At the second stage, to determine the level of resistant activity of the oral cavity in 37 in the main and in 44 adolescents of the control group, immunological studies were performed – determination of the content of immunoglobulin A (IgA) of blood and secretory immunoglobulin A (sIgA). The material of the study was the blood and saliva of the patients. Blood sampling was performed on an empty stomach. Blood was collected in an amount of 2 ml in test tubes with a red marking. The results were obtained on the following day. Saliva sampling was carried out from 8:00–9:00, according to the method proposed by Malyshev M.E., Lobeiko V.V. [9].

Blood IgA was analyzed in a Siemens ADVIA Centaur CP system immunoassay analyzer (Diagnostic Systems reagent kit for immunoglobulin A (IgA), reference values in the range of 0.7–4.0 mg / ml. In the saliva, the sIgA quantitative level was determined by enzyme immunoassay (ELISA system -BEST-STRIP, CJSC Vector-Best, Russia, and was determined in the range of reference values – 0.04–0.29 mg/ml.

Statistical processing of the data was performed using the standard software of the software Statistics for Windows 10.0. The reliability of intergroup differences for averages and relative values was determined considering the error of representativeness according to Student's criterion (p <0.05).

IV. RESEARCH RESULTS

C. Data of objective examination of the oral cavity

A detailed study of the dental status was carried out in two groups, among adolescents living in an environmentally unfriendly area (main group) and among representatives of the control group living in an area without ecotoxins. Data on the state of soft and hard tissues were refined by a detailed examination using laboratory and instrumental diagnostic methods and determination of indices.

According to the data obtained, caries was detected in adolescents from an environmentally unfriendly area in 90.0 %, in control in 63.6 % (p<0.01). The average intensity of dental caries in the control group turned out to be 3.4 ± 0.5, which corresponded to the average values in the population, and in the group of adolescents from the industrial zone, it was almost twice as high – 6.3 ± 0.4 (p<0.01), which corresponded to a high intensity of the carious process.

Analyzing the data of the Fedorov-Volodkina index, we should note the unsatisfactory level of oral hygiene in the group of teenagers from the industrial zone, the quantitative assessment of the index was 2.4 ± 0.3. In the control group, the values of the index 1.4 ± 0.2 (p<0.01) indicate a satisfactory hygiene indicator. Systematizing the teeth staining indices and determining the qualitative assessment of the index, it should be noted that in 72.0 % of cases 2.4 points of staining are recorded; in 24.0 % – 3 points; and only 4.0 % of the representatives of the main group showed no staining. Data of the control group – in 63.6 % of cases, 1 point of staining is recorded, in 36.3 % – 2 points of staining are noted.

Investigating the vestibular surfaces of the teeth 1.1, 1.6, 2.6, 3.1 and oral surfaces 3.6, 4.6 in adolescents in the main group, plaque was found in 100 % of cases, tartar – in 76.0 %.
Thus, the simplified index of hygiene averaged – 2.5 ± 1.2. In the control group, the UIG values were only 1.1 ± 0.3.

The definition in the clinical practice of gingival index (GI) is quite informative and indicates the effect of dental deposits on the severity of gingivitis. According to the data obtained, it can be concluded that in the main group in 40.0% of cases gingivitis of mild severity is detected, in 50.0% in moderate and 40.0% of severe cases. In the control group, only mild gingivitis was detected in 22.7% of adolescents.

The CPITN index, the results of the study determine the status of dental status, indicate the need for dental care and evaluate the effectiveness of treatment of periodontal disease. In 78 adolescents from the industrial zone, clinical manifestations of inflammation of the gums and dental plaque were noted, but periodontal pockets were absent, which corresponds to a coding of 2 points. In 4 adolescents, the periodontal status was 1 point. 8 teenagers revealed periodontal pockets (3 points). In the presence of periodontal pockets, in addition to conducting individual oral hygiene, it is also necessary to conduct non-surgical methods of periodontal therapy. In 77.2% of patients in the control group, the state of the oral cavity and the need for therapeutic treatment is estimated at 0 points, and only at 22.7% – at 1 point.

Diseases of the oral mucosa in the main group were detected in 9 adolescents, but not in the control group. Basically, the diagnosis of leukoplakia of the oral mucosa was made. It should be noted that in most cases the disease occurs in response to chronic exogenous irritation.

Examination of the oral cavity revealed the need for orthopedic treatment in some adolescents of the main group (16.0%), the need for replacing 1 tooth. This clinical picture is due to the rate of progression of the carious process and, ultimately, the need to remove the causative tooth. In the control group, only one teenager (2.3%) had a defect in the dentition.

The frequency of occurrence of dental anomalies in adolescents of the main group was 78.0%, in the control group – 56.8% (p<0.01). At the same time, about half of them need advice and specialized help from a dentist-orthodontist.

D. State of immunological status

According to modern immunological concepts, the leading role in the development of dental pathology is given to the violation of the compensatory mechanisms of the natural immunity of the oral cavity, reducing the local resistance of the organism in response to the impact of adverse environmental factors.

Sustainable to the action of enzyme systems of saliva sIgA is the main immunoglobulin, effectively providing local humoral immunity. Secretory IgA is able to maintain the integrity of the oral mucous membranes by inhibiting the adhesion of bacteria to epithelial surfaces and teeth and causing neutralization enzymes, toxins, and viruses or acting synergistically with other antibacterial factors such as lysozyme, lactoferrin, peroxidase saliva and mucus [9 10–12].

The leading role in the system of local immunity of the mucous membranes is assigned to the secretory immunoglobulin A (sIgA). According to information sources, the deficiency of sIgA in gingival secret and saliva causes a tendency to recurrent inflammatory diseases in the oral cavity, therefore, its determination is an important diagnostic test determining the level of resistance of local immunity [8–10, 12].

According to the literature, the adequacy of the immune response to inflammatory changes in the mucous membrane of the oral cavity is determined by an increase in the sIgA level in saliva, which ensures normal tissue resistance [13]. According to the study, indicators of sIgA level in adolescents with periodontal pathology from an environmentally unfriendly area were 0.06 ± 0.012 mg/ml, which corresponded to the lower limit of reference values, and were significantly lower relative to its increased rates (0.56 ± 0.18 mg/ml; p<0.01) with inflammatory periodontal diseases in the control group. A decrease in the sIgA level is accompanied by the activation of conditionally pathogenic microflora in the oral cavity, which contributes to the aggravation of inflammatory processes [9, 10, 14].

Studies of saliva in adolescents from an environmentally unfriendly area revealed an increase in the degree of tension in the body's protective systems. Only in 5.0% there were no changes in the values of immunoglobulin A saliva. Only in some adolescents (15.0%) the sIgA content was at the level of the upper reference values, which could be a manifestation of a compensatory response to the toxic effects of the environment.

Thus, the lack of an adequate response in the sIgA content to the inflammatory process in adolescents from an environmentally unfriendly area appears to be the result of the influence of ecotoxins of the industrial zone, resulting in the disruption of local immunity of the oral mucosa.

According to the results of laboratory studies, the content of blood IgA in adolescents of both groups was within its reference values. However, immunoglobulin A in some adolescents (27.0%) from an ecologically unfavorable area corresponded to lower values of the reference interval.

V. THE FINDINGS OF THE STUDY

Analysis of the results allowed to clarify the dental status of the examined adolescents of both groups, revealing the presence of poor hygiene and many diseases of the dental-maxillary system (caries, gingivitis, dental anomalies, etc.). However, both for the prevalence of caries, and for other existing pathologies, a significant dependence on the area of residence of adolescents was revealed. The data obtained indicate a significantly higher prevalence of pathology and a more severe course in adolescents from an environmentally unfriendly area.

According to the results of the study, the deviation of sIgA from the reference values, the decrease in its values in many adolescents exposed to ecotoxins, is a predictor of the resistance of local humoral protection systems in the oral cavity. Changes in the natural barrier systems of the oral mucosa can contribute to the development of pathological processes on the part of other organs and systems.
References


