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Research Article

Correction of disordered oral immunity in children affected by dental caries with herbal immune modulator "Esberitox"

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Abstract

Dental caries is the most prevalent pathological condition in the child population of Ukraine. Despite the achievements of medical science, dental caries in children remains one of the most actual problems nowadays. Epidemiological investigations conducted in different regions of Ukraine demonstrate that 62% of children have decay and in many parts of the country the statistic is even higher up to 96.5% when the intensity of carious damage fluctuates between 3.2 to 7.2 teeth. This article reflects the results of the study regarding correction of disordered oral immunity indexes by immune modulator "Esberitox" in children affected by different caries activity. We have confirmed the high efficiency of the recommended scheme of caries prophylaxis that is proved by positive dynamic of oral immunological indexes observed 24 month after the beginning of the research. There was a certain rise of lysozyme by about 21.1% and s-IgA has increased by 28% in children from prophylactic groups in comparison with control groups.

Keywords

children, dental caries, lysozyme, oral liquid, secretory immunoglobulin A

Introduction

Dental caries still affects large numbers of children up to 98% according to some epidemiological findings and there is little improvement of this problem. The statistic varies worldwide from 1% to 70% and there is a difference in levels of decay between the communities. The investigation by Brown et al. (2000) suggested that by 2 to 6 years of age the child population in USA has experienced dental decay due to not efficient prophylaxis. Therefore, caries presents a big social and health problem in the world.

In Ukraine the statistic also illustrates the high level of caries intensity and prevalence. According to Denha et al. (2013) the prevalence of tooth decay among preschoolers is 48% by intensity 1.09–2.5 teeth in the central regions of Ukraine, in the West Ukraine, on the other hand, the prevalence in this age group reaches up to 97% and intensity of the dental decay is 7.1 teeth.

The child's body is at the constant state of development and it has been established that caries and its complications might cause a massive influence on the maxillofacial system and health in general. The decay is also affected by detrimental environmental pesticides and other chemicals in products, water and soil. The role of eco-pathogenic risk is of vital importance in pediatric stomatology as any hazardous substances may be extremely harmful in any amount and doses to the child's well being. The statistic provided by Bezvushko (2010) show that worsening of specific and not specific defense factors and oral in particular lead to development of immune pathological

conditions that complicate caries, not carious abnormalities and periodontal disorders.

The findings of Borovskyy and Leontyev (2001) suggested that cariogenic potential is related to the main factors such as microbial agent and quality of the hard dental tissues that determines processes of demineralization and remineralization. The level of immune-biological resistance of the body is considered as being of vital importance. Hilyaseva (2012) claimed that the state of local oral immunity defines the course of carious process as acute or systemic that was proved by many laboratory and clinical investigations.

According to Ovruckyy et al. (1991) the secretory immunoglobulin A(s-IgA), lysozyme and other defense factors provide antibacterial, antiviral and antitoxic mechanisms of oral liquid. The role of s-IgA is neutralization of viruses, bacterial exotoxins and enzymes; it inhibits adhesion of bacteria to epithelial cells and dental surfaces. The study of Atler (2007) show that bacteriostatic, bacteriolytic and bactericide characteristics of lysozyme are based on its ability to destroy peptidoglycans of the cell wall and finally lead to their lyses. The researches of (Chawda et al. 2011; Chereda et al. 2012; Haeri-Araghi et al. 2018) demonstrated very controversial findings about the content and the role of s-IgA in oral liquid of children resistant and sensitive to dental caries.

The article demonstrates the results gained by correction of oral immunity indexes in 12 year old children with different caries activity by administration of herbal immune modulator. The results showed that the rational usage of "Esberitox" increases s-Ig A and lysozyme in oral liquid of the main group comparing with the control group.

Materials and methods

We have investigated sixty-one 12 years old children affected by dental caries. The main group consisted of 30 children, the control group-of 31 children. Dental examination was performed according to methods recommended by WHO (2013). The caries activity was assessed by T. Vinogradova: compensated (DMF1–3); sub-compensated (DMF 4–6); de-compensated (DMF 7–9). Children from the main group were provided with caries treatment and oral hygiene. These children were prescribed the immune modulator "Esberitox" (manufactured by „Shaper & Brummer GmbH & Co. KG", Germany; with a registration number: UA/11978/01/01). Each tablet contains 3.2 mg of dry extract (4–9:1) of an offset: *Baptisia tinctoria* rhizome; *Echinacea purpurea* and *Echinacea pallida* roots; young shoots and leaves of *Thuja occidentalis* L.. The pharmacological agent should be taken by the following scheme: 3 tablets 3 times a day swallowed with plenty of water. The duration of the treatment was 14 days. The endogenic prophylaxis was repeated twice a year (autumn and spring) over 2 years for the children of the prophylactic group.

Children from the control group were introduced with oral hygiene and caries treatment.

The efficiency of the recommended treatment was assessed by content of lysozyme and s-IgA in oral liquid of children. Oral liquid was collected in the morning before breakfast by a sterile pipette from the cavity floor into a sterile container. To estimate lysozyme in oral liquid the day flush of agar *Micrococcus lysodeicticus* 1/15 M with phosphate buffer pH 6.2 was prepared in advance. The obtained suspension of Micrococcus was standardized by photo-electro-calorimeter KFK-2 with a green light filter until the optical density of 0.66. Defrosted oral liquid 0.1 ml was poured into a test tube (diluted 4 times with 1/15 M of phosphate buffer pH 6.2) and 2.0 ml of standardized suspension of Micrococcus. The phosphate buffer 0.5 ml pH 6.2 1/15 M and 2.0 ml of suspension of Micrococcus were transferred into three control tubes. The tubes were incubated for 30 minutes at temperature 37 °C and optical density was estimated using KFK-2 by the right drum with a green light filter. The amount of lysozyme was assessed by the special gauge tables measured in mcg/ml.

The study of oral humoral immunity was conducted by estimation of secretory immunoglobulin A(s-IgA) in oral liquid using immune enzymatic analysis with the reagent kit „s-IgA – IFA-BEST" (ZAT „Vector Best , Russia").

We followed the ethical standards when working with the examined children and obtained the written permission from both parents for collection and investigation of biological materials.

The data was processed with Statistica 10.0 and the obtained results were analyzed using the Student distribution law. The difference between the compared groups was considered as statistically proved if the obtained probability index (p) did not exceed the selected initial level ($\alpha = 0.05$) or was equal, therefore $p \leq 0.05$) was used as significance level.

Results

There has been a steady rise of lysozyme in oral liquid by 11.52% from (33.25±1.52) to (37.5±1.67) mcg/ml in children of the main group diagnosed with compensated caries established 24 month after the recommended complex in contrast to initial data ($p < 0.05$) (Table 1).

The positive changes of lysozyme have also been noticed in children diagnosed with sub-compensated caries 2 years after the treatment and have increased in 1.4 times comparing to initial data($p < 0.05$).

However, the most impressive results have been achieved in children with de-compensated caries when the amount of lysozyme has increased by 33.28% from (19.31±2.34) mcg/ml to (28.94±2.31) mcg/ml ($p < 0.05$) that was recorded 2 years after the recommended complex treatment.

In children of the control group, on the other hand, the indices of lysozyme did not differ from the initial data according to examination taken 2 years after the beginning of the research ($p > 0.05$).

Table 1. Indices of lysozyme and s-IgA in oral liquid of children before and after treatment (M±m).

Indexes	Main group		Control group	
	Before treatment	After 24 month	Before treatment	After 24 month
Compensated dental caries				
Lysozyme, mcg/ml	33.25±1.52	37.5±1.67	32.64±1.47	33.1±1.66
S-IgA, g/l	0.24±0.02	0.28±0.02	0.23±0.03	0.24±0.02
Sub-compensated dental caries				
Lysozyme, mcg/ml	24.55±2.14	33.1±2.31*°	24.38±2.16	22.1±2.52
S-IgA, g/l	0.17±0.03	0.25±0.02*°	0.18±0.03	0.17±0.03
De-compensated dental caries				
Lysozyme, mcg/ml	19.31±2.34	28.94±2.31*°	18.94±2.36	17.39±2.22
S-IgA, g/l	0.13±0.03	0.22±0.02*°	0.14±0.03	0.13±0.03

Note: 1. * – the difference between the indices in children from the main and control groups recorded 24 month after the treatment within a zone is certain ($p < 0.05$). 2. ° – the difference between the indices in children before and after 24 month within a group is certain ($p < 0.05$).

There is an evidence to summarize that there was a rise of s-IgA by 14.29% ($p > 0.05$) observed in children with compensated caries after the appointed treatment. Comparing the end and the beginning of the research we have recorded also an 1.47-fold increased amount of s-IgA ($p < 0.05$) in children diagnosed with sub-compensated caries. The analysis of s-IgA in children with de-compensated caries shows a 1.7-fold rise in the values from (0.13±0.03) to (0.22±0.02) g/l ($p < 0.05$). Concentration of s-IgA has not experienced any changes in children from the control groups after 2 years ($p > 0.05$).

Discussion

The findings of the study (Chomenko et al. 2013; Smolyar and Barylyak 2013) reflected the link between the occurrence of many oral diseases and general and oral immunity. According to data provided by M.A. Havrylenko (2015) there are severe periodontal distractions and damages of the hard dental tissues in children with disability despite prescribed topical anti-inflammatory therapy and improvements of oral hygiene that is proved by a rise of white cells and a decrease of epithelial cells in the sedimentary part of oral liquid. Investigations of Atler (2007) illustrated that s-IgA is the main humoral factor that affects bacterial metabolism and regulates normal oral microflora. The deficiency of s-IgA can lead to disorders between the oral microflora and the macro organism. The s-IgA inhibits microbial adhesion to the hard dental tissues and as a result contributes to development of dental caries and periodontal disorders. According to Doifode and Damle (2011) dental caries is a consequence of sensibilization in local immune system to auto-anti-genes of enamel or products of their modification that evolve influenced by physical, chemical and bacterial factors. The findings by L. Chomenko (2012) suggest that the increase of s-IgA in children of early age is influenced by extended activity of cariogenic microflora. In contrast, in children with decayed smooth surfaces of primary teeth, the level of s-IgA is much lower that can be explained by high microbial overloading and exhaustion of this immune link upon immaturity of the secretory immunity. As can been seen from our investigation, concentration of s-IgA depended on the severity of carious process that also correlates with other surveys (Chawda et al. 2011; Doifode and Damle 2011; Chereda et al. 2012).

The oral enzyme lysozyme is one of the important factors that catalyzes the hydrolysis of 1,4-beta-linkages between the carbohydrate units in the polysaccharide backbone in peptidoglycan. The results of the researches conducted by (Bezvushko 2010; Hilyaseva 2012) reported that another role of this enzyme is the stimulation of phagocyte activity of leucocytes and participation in tissue regeneration. The data provided by N. Smolyar (2013) indicate the enhanced spectrum of microbial association in dental plaque of children with de-compensated caries and decline of lysozyme in oral liquid. The other author B. Chereda (2012) suggests that there is a misbalance between the microbial load and local immunity reflected in changes of biofilm followed by shifting of the hydrogen index to the acid side and increases demineralization of the hard dental tissues. The obtained data regarding the reduction of lysozyme activity in case of caries progression is confirmed by other sources and can be used in the diagnosis of this disease (Lertsirivorakul et al. 2015; Lertsirivorakul et al. 2015).

Conclusions

The results gained 24 month after the appointed treatment suggest that in children from the main group with sub-compensated caries there was a certain 1.5-fold increase of lysozyme; in children with de-compensated caries this index has increased 1.7 times as compared to the initial statistical data and indices in the control group ($p < 0.05$).

The amount of s-IgA has increased by 32% 2 years after the recommended treatment in children with sub-compensated caries and there was a growth by 41% in children with de-compensated caries in comparison to the initial level ($p < 0.05$).

There has been a marked progress in prevention of dental caries by administration of the herbal immune modulator in children with moderate and high caries activity and we definitely recommend it for endogenic prophylaxis.

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