STATE OF HUMORAL IMMUNITY OF CHILDREN WITH THE SYSTEMATIC ENAMEL HYPOPLASIA, WHO LIVE IN POLLUTED AREAS OF IVANO-FRANKIVSK REGION

Yu. A. Labiy, G. M. Melnychuk

SHEI "Ivano-Frankivsk National Medical University", Ivano-Frankivsk, Ukraine

Summary: The immune system of the child suffers from an effect of wide range of xenobiotics from polluted environment. This indirectly affects the function of bone, endocrine and other systems of the body, which leads to the imbalance of adaptation processes and chronic pathological conditions, including systemic enamel hypoplasia (SEH) of teeth. Levels of immunoglobulins of A-, M-, G- classes in blood plasma were defined by radial immunodiffusion to study the state of healthy children immunity from relatively clean district of Ivano-Frankivsk region and to establish the interrelation between the level of immunoglobulins in the blood plasma that are responsible for humoral immunity of children suffering from SEH and nature of their habitat contamination. The study involved 133 children suffering from SEH, who live in different by nature of anthropogenic pollution parts of Ivano-Frankivsk region, and 63 children from relatively pure area which was selected as a control one. It was found a significant decrease of immunoglobulin indicators of all classes in blood plasma of residents from contaminated districts in comparison with the data of residents from conditionally clean district. It was found a dependence of the level of immunoglobulins on the type of pollution. The least affected is the immune system of children, living in district, contaminated with inhalant xenobiotics. The worst state of the immune system was found in children, residents of the district with chemical and radiological nature of anthropogenic load, that indicates an extremely harmful effects of combined contaminations on the child's organism. The founded regularities allow to develop the complex of measures for the treatment and prevention of adaptation processes violations, which can lead to the formation of tooth enamel defects.

Keywords: children, systemic enamel hypoplasia, immunoglobulins of A-, M-, G- classes, environmental pollution.

In the 90 years of the twentieth century doctors faced with a new global problem associated with damaging effects of increasing range of environmental pollutants on the immune system. An increase in immune-mediated human diseases, including systemic enamel hypoplasia (SEH) of teeth in children is associated with the effect of the xenobiotics [7].

Children's health is one of the most sensitive indicators and criteria of influence the environment and lifestyle on human population [1]. This has a particular importance in assessing environmental quality in industrial areas where the population is undergoing significant anthropogenic pressure [3].

Human immune system is one of the most important mechanisms of organism adaptation to constantly changing environmental conditions. The peculiarity of the child's immune system lies in the fact that it is in the process of formation and development; this determines the uniqueness of its response to antigenic stimulation. The immune system provides not only the protection against infections, but also has the function of control and support of the antigenic homeostasis of organs and tissues [5].

Like all functional body systems, the immune system possess a certain autonomy and capacity for self-regulation and is closely linked to the activities of bone, endocrine and other body systems. There is a certain mutual influence and dependence between them [8]. A variety of environmental changes (cold, air pollution, etc.), food, habits, and numerous infections have a significant impact on immunological resistance of children' organism. These changes are not only parts of the general changes in physiological systems of the child, but are also dependent on them, and are adaptive in its biological significance. [9]. Some mechanisms of natural immunity, which very subtly react to external actions and violations of a constant internal environment, may serve as objective indicators of general physiological condition of the body and are used as a diagnostic test to indicate the hidden pathological or adaptive processes [2].

In this regard, the **aim of our work** was the establishment of the relationship between the level of immunoglobulins which are responsible for humoral immunity in the blood plasma of children suffering from SEH and the nature of territory contamination of their residence and examining the state of immunity of healthy children from relatively clean areas of Ivano-Frankivsk

Materials and methods. Immunoglobulin level in blood plasma IgA, IgM, IgG was studied by Mancini method of radial immunodiffusion in order to establish the features of humoral immunity of patients with SEH and healthy ones. [6]. The object of the study were children with different degree of SEH intensity of permanent teeth: 27 pupils from Zadnistryanske village of Galych district suffer from a high air pollution caused mostly by emissions into the atmosphere of coal combustion gases at Burshtin power plant [4]; 26 children from the village Verchnia of Kalush district, residing in the territory contaminated with products of chemical industry- organic macromolecular compounds from activity of the plant-giant "Lukor"; 36 children of the village Javoriv Dolina district that is a locality with heavy contamination of drinking water with harmful substances from oil and gas production complex; 44 children from the village Stetseva of Snyatin district, which, according to the Resolution of the Cabinet of Ministers of Ukraine №106 of 23 July 1991, assigned to the zone of enhanced radiation monitoring (IV zones of radiation contamination after accident at the Chernobyl AES) [10]. In this village and in the adjacent areas were detected spots of radiation contamination up to 5 Curie / km2. As a benchmark we used data on humoral immunity of 63 healthy children from relatively clean Horodenka district. Age of children ranged from 6 to 15 years.

Results and discussion. Our research revealed, that level of IgA in healthy children was 2,01±0,09 g/l, and in all children with SEH from contaminated areas together – 1,72±0,04 g/l. The difference between the rates makes 1,17 times ($p<0,01$), that is shown in the figure 1.

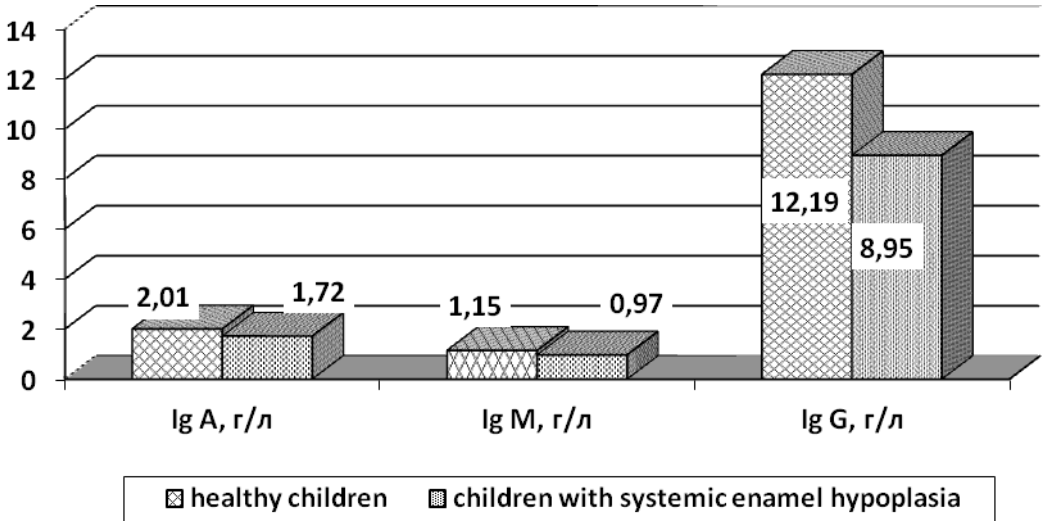

Figure 1. Humoral immunity status in healthy children and in all children with systemic enamel hypoplasia of permanent teeth, living in polluted areas of Ivano-Frankivsk region.

The data on IgM content in plasma in children with SEH, differs from one in healthy children in 1,19 times ($p<0,001$), in healthy children making 1,15±0,09 g/l, and in all sick children, who are under the influence of different xenobiotics,– 0,97±0,01 g/l. In the terms of the number of IgG was found, that difference between the data of healthy children and children with SEH, from anthropogenically polluted areas, makes 1,36 times ($p<0,001$), and the rates come to 12,19±0,13 g/l and 8,95±0,18 g/l in accordance.

Therefore, the analysis of the humoral immunity indicators in all children with SHE found that the immunoglobulin level in patients significantly reduced in comparison with the one in healthy children.

The changes of the immune parameters of the children with SEH from contaminated areas are separately listed in the chart 1. It was detected that the level of IgA in blood of sick children have been reduced against the indicators in healthy children from all districts: from 1,1 times ($p_1>0,05$) – in Galich district, 1,12 times ($p_1<0,05$) – in Dolyna district, 1,21 times ($p_1<0,01$) – in Kalush district, to 1,22 times ($p_1<0,001$) – in Snyatin district. There wasn't found a significant difference between these indicators in districts with different nature of pollution.

After the analysis of the IgM content in blood plasma of children with SHE there was found a significant difference between indicators of all contaminated districts and conditionally clean district. Herewith, the lowest level of IgM was in Snyatin district (0,90±0,02 g/l), which differs in 1,27 times form the indicator in healthy children form Gorodenka district (1,15±0,03 g/l), $p_1<0,001$. Indicators of Galich district appeared to be the largest among the contaminated districts (1,03±0,04 g/l), which although significantly differed from those in conditionally clean district, but were lower than they in 1,12 times ($p_1<0,05$). Significant difference between the indicators of IgM from different polluted districts was not observed.

Table 1

Humoral immunity indicators in healthy children and children with systemic enamel hypoplasia of permanent teeth, living in districts of Ivano-Frankivsk region with different environmental pollution (M±m)

Indicators in blood serum	Healthy children	Children with SEH			
	Gorodenka district, n=63	Galich district, n=27	Dolyna district, n=36	Kalush district, n=26	Snyatin district, n=44
Ig A, g/l	2,01±0,09	1,82±0,09 $p_1>0,05$	1,79±0,07 $p_1<0,05$ $p_2>0,05$	1,65±0,11 $p_1<0,05$ $p_3>0,05$ $p_5>0,05$	1,64±0,06 $p_1<0,001$ $p_4>0,05$ $p_6>0,05$ $p_7>0,05$
Ig M, g/l	1,15±0,03	1,03±0,04 $p_1<0,05$	1,01±0,03 $p_1<0,01$ $p_2>0,05$	0,96±0,03 $p_1<0,001$ $p_3>0,05$ $p_5>0,05$	0,90±0,02 $p_1<0,001$ $p_4>0,05$ $p_6>0,05$ $p_7>0,05$
Ig G, g/l	12,19±0,24	9,12±0,45 $p_1<0,001$	9,39±0,38 $p_1<0,001$ $p_2>0,05$	8,71±0,38 $p_1<0,001$ $p_3>0,05$ $p_5>0,05$	8,95±0,18 $p_1<0,001$ $p_4>0,05$ $p_6>0,05$ $p_7>0,05$

Note. Probability of indicators difference is displayed: p_1 – all districts to the quantity of healthy children from Gorodenka district; p_2 – Galich district to the quantity of Dolyna district; p_3 – Galich district to the quantity of Kalush district; p_4 – Galich district to the quantity of Snyatin district; p_5 – Dolyna district to the quantity of Kalush district; p_6 – Dolyna district to the quantity of Snyatin district; p_7 – Kalush district to the quantity of Snyatin district.

The level of IgG in blood plasma of children with SEH, was also significantly lower in comparison with the same in conditionally clean district ($p_1<0,001$). The indicators of Dolyna district differs the least from the data of healthy children (the increase was in 1,30 times), and the most - in Snyatin district (in 1,36 times) and in Kalush district (in 1,39 times). There wasn't found a significant difference between IgG content in blood plasma of children with SEH form districts contaminated with different xenobiotics.

So, the data obtained by us allows to suggest that environmental pollution contributes to a significant reduction in humoral immunity indicators, that indicates an immune system depletion of children, living in anthropogenically polluted areas. Herewith, the least affected is the immune system of children, residents of Galich district that is contaminated with inhalant xenobiotics. More damaged is the immune system of children, living in the territories where the water and the soils are contaminated with chemical xenobiotics, namely in Dolyna and Kalush districts. The worst condition of the immune system was detected in children from Snyatin district. That indicates that the combination of chemical and radiation contaminations have

an extremely harmful effect on child's organism.

Conclusions.

1. It was found the reduction of IgA level in blood plasma of children with SEH from all districts with a difference from healthy children from 1,1 times ($p_1>0,05$) - in Galich district to 1,22 times ($p_1<0,001$) – in Snyatin district.

2. The IgM content in blood plasma of children with SHE is significantly smaller in all polluted districts, especially in Snyatin district (in 1,27 times; $p_1<0,001$).

3. The amount of IgG of all children with SEH was significantly reduced regardless of xenobiotics, however, in comparison with healthy children, this indicator was especially reduced in Kalush and Snyatin district (in 1,39 and 1,36 times; $p_1<0,001$).

4. All eco pathogens, which have been studied by us, significantly affect the humoral immune of children suffering from SEH, however, the immune system of children exposed to inhalative xenobiotics was affected the least, and the combined chemical - radioactive contamination that occurs in Sniatyn region has a particularly negative impact on the immune system of children.

Prospects for further research.

Prospects for further research is the development and implementation of therapeutic and preventive complex for correction of the detected violations.

REFERENCES

1. Antonova A. A. The presence of ecotoxicants - a risk factor for dental disease / A. A. Antonova, V. A. Ryabkova, V. S. Talovskaya // Pediatric Dentistry. – 2006. – №3-4. – C. 11–14.
2. Bodienkova G. M. Comparative evaluation of humoral immunity indicators of children living under conditions of different ecological tension / Bodienkova G. M., Fominyh I. B., Bodienkova S. G. // Topical issues of Pediatrics. Bulletin ВСНЦ СО РАМН. – 2005. – №5(43). – P. 133-135.
3. The dynamics of the health status of children in Belarus living in ecologically unfavorable conditions / A. N. Arinchin, T. V. Avhacheva, N. A. Gres, E. I. Slobozhanina // Public Health. – 2002. – №1. – C. 16-22.
4. Environment of Ivano-Frankivsk in 2010: Statistical Yearbook / State Statistics Committee of Ukraine, Main Statistic Department in Ivano-Frankivsk; [edited by L. O. Zbroy]. – Ivano-Frankivsk. – 2011. – 151 c.
5. Zolotnikova G. P. Changes in immunity rate of adolescents, who are students of professional lyceums, in conditions of technogenic environmental pollution // G. P. Zolotnikova, R. V. Kurguz // [Electronic resource]. – Access mode: http: //www.rusnauka.com/6_PNI_2013/Ecologia/1_130374.doc. htm
6. Immunology: [Electronic resource]. – Access mode: http: // imuno.net/73.php
7. Environment and dental health of children in Ukraine / L. O. Homenko, O. I. Ostrapko, N. V. Bidenko, O. O. Timofeeva // Archives of Clinical Medicine. – 2004. – №1(4). – P. 82-85.

8. The syndrome of endogenous intoxication in children with hypoplasia of tooth enamel, residing in the territory contaminated with genotoxic factors / G. S. Chaikovska, O. Z. Gnateiko, O. V. Jezierska, O. Z. Chala-Masna // Journal of dentistry. – 2008. – №3. – P. 59-62.
9. The health status of children in the area of environmental disaster (Sosnivka city of Lviv region) / N. I. Smoliar, D. D. Zerbino, N. M. Skaletska, E. V. Bezvushko // Environment and Health. – 2004. – №3. – P. 18-23.
10. Chernobyl consequences in Ivano-Frankivsk / O. P. Kiriyak, V. V. Pantazi, V. V. Murzov [and others] // Hygiene of settlements. – K.: Polymed. – 2001. – T.2. – P. 168-169.