ASSESSMENT OF HYGIENIC FAVORABLE CONDITIONS OF THE AREAS ON THE BASE OF MONITORING URINE TOXICITY OF CHILDREN

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The degree of chemical pollution of the organism internal environment shows the influence of chronic chemical loads and it is a marker of prenozologic conditions of human body. The analysis of the chemical pollution level of inner body within population groups, who live permanently on the same place, can be useful for hygienic assessment of the area favorable for living. We have studied the possibility of such an assessment on the base of monitoring urine toxicity of children who attend municipal preschool educational institutions.

Urine is an end-product of human body. Metabolic processes and environmental factors influence on the chemical composition of urine. Urine shows to a large extent internal environment pollution and it is the easiest-to-get biological material suitable for noninvasive diagnostics. Urine sampling does not affect the internal environment and it causes no discomfort to a person under examination. Moreover, sampling makes it possible to examine at the same time many people including children and it needs no special conditions for urine conservation and transporting. Urine toxicity is an integral parameter that shows the degree of internal environment pollution under the action of both exogenous and endogenous factors. Urine toxicity depends on waste products and toxins which urine contains. They are formed within the organism as end products of metabolic processes and, as a rule, they consist of small and medium molecules. Due to kidney filtration and reabsorption, toxins and waste products are discharged with urine, and tissue fluid, lymph and blood remain slightly toxic. It results in relatively dynamic stability of internal environment – homeostasis.

The method used to assess the urine toxicity is based on the influence of the examined solution on the motility of short-time suspension culture of mammals motile cells — bull spermatozoa suspension. The measuring parameter is the motility of bull spermatozoa suspension m, which is proportional to the moving spermatozoa concentration c_m and average modulus of the cell velocity v:

$$m = c_m v$$

The bull spermatozoa suspension motility $m=m(t)$ for reference and examined samples is measured during period of time till motility becomes close to zero (fig.1).

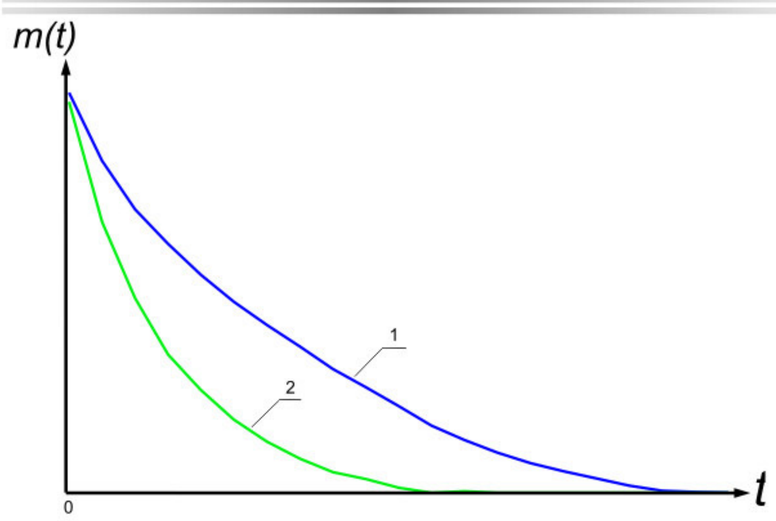

Fig. 1. Motility of spermatozoa suspention versus time for reference and examined samples. 1- reference sample; 2-examined sample.

The characteristic of suspension motility function $m=m(t)$ summary suspension motility.

$$S = \int_t m(t)dt$$

is used as endpoint. Then the result of examination is received in the form of toxitciy index I_t^S equal to ratio of corresponding endpoint values for examined and reference samples.

$$I_t^S = \frac{S^{exam}}{S^{ref}} \cdot 100\,\%,$$

where S^{exam}, S^{ref} - summary suspension motility for examined and reference samples.

Using integral characteristic of cell suspension motility function $m=m(t)$ as endpoint increases test method susceptibility and reprodusibility.

In practice measuring process of toxitciy index I_t^S is rather simple. Frozen cells stored in liquid nitrogen in Dewar vessel are used that allows to ensure the unlimited storage and reduce time for work preparation up to 10 min. It is a cheap and accessible biological material which is easy to produce thanks to well developed processes of arttificial fertilization and readily availiable from the rejected hereditary-inadequate stock. The examined and referece solutions are prepared as follows. Granule of the bull's frozen sperm is defrosted in glucose-citrate medium at the temperture of 40C after which 0,2 ml of the defrosted spermatozoa suspension is added to 1 ml of the examined and reference samples. The sell concentration is adjusted to make period of expirement not longer than 3 hours. 4 g of glucose, 1 g of sodium citrate, 100 ml of distilled water is used as reference medium. The isotonicity of the examined urine sample is adjusted by adding dry glucose and sodium citrate and then diluted 1:2 by glucose-citrate medium. During the entire experiment the temperature maintains 40C. Disposable glass capillaries of 25 mcl volume are applied as chambers. The motility of spermatozoa suspension is measured by specialy developed toxicity analyser (Fig. 2).

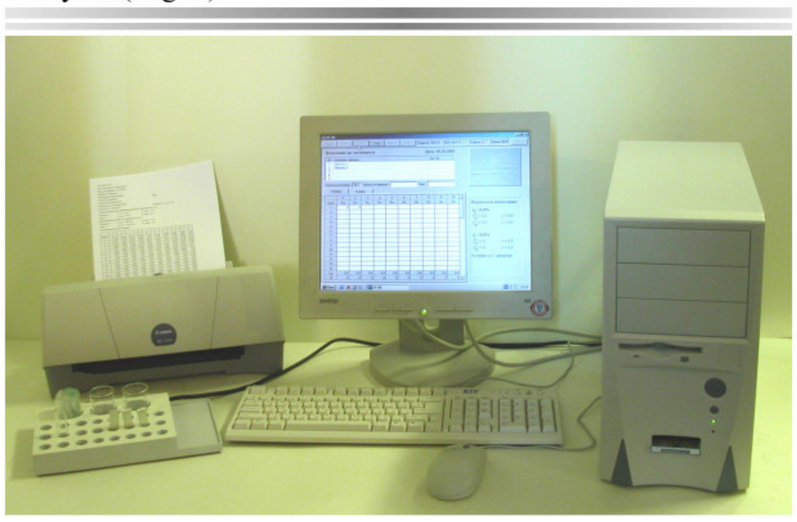

Fig. 2. Toxicity analyzer.

The operating principle is based on real time automatic computer microscopic videoimage analysis of spermatozoa suspension. The values of bull spermatozoa suspension motility for reference and examined mediums are measured in equal intervals and accumulated, till motility becomes close to zero. Then toxitciy index I_t^S is calculated.

Children at the age of 2-6 have been examined. They attend municipal preschool educational institutions, of the similar architectural design, with similar daily routine and educational programs. But they are located in the places with different environment pollution level. We have chosen two cities — Voronezh and Lipetsk — due to the data of long-term environmental monitoring within the scope of social and hygienic monitoring program. In Voronezh, the children of the test group attend the preschool institution in the district of Birch Copse, Agricultural University. This is a hygienically favorable area. Children of the study group attend the preschool institution set along Moscow Avenue, Rabotchy Avenue, near Polytechnic University. This is a so-called hygienically unfavorable area.

We have examined 190 children: 78 persons live and attend institutions in hygienically favorable area, and 112 persons —in hygienically unfavorable zone. In Lipetsk, the children of the test group attend the preschool institutions in Microdistrict 19 (hygienically favorable area), the children of the study group attend the preschool institution quite near the Novolipetsk Steel Works. We have examined 100 children – two groups of 50 children each, living and attending institutions in hygienically favorable and unfavorable area. Urine samples were taken as soon as the children woke up in the afternoon. Toxicity index for each sample has been determined.

The results have been estimated by comparing frequency distributions of urine toxicity indexes of the corresponding groups (see fig.3, fig.4). The qualitative comparison of the distributions has been performed by examining the average value of toxicity index (see Table). The comparison of any two groups has demonstrated true difference at the significance level of $P << 0{,}001$. As shown in fig.3 and fig.4, distributions relating to the groups of children who live in hygienically unfavorable area in both cities are shifted towards lower values of toxicity indexes. It means that examined samples are of a higher cytotoxicity.

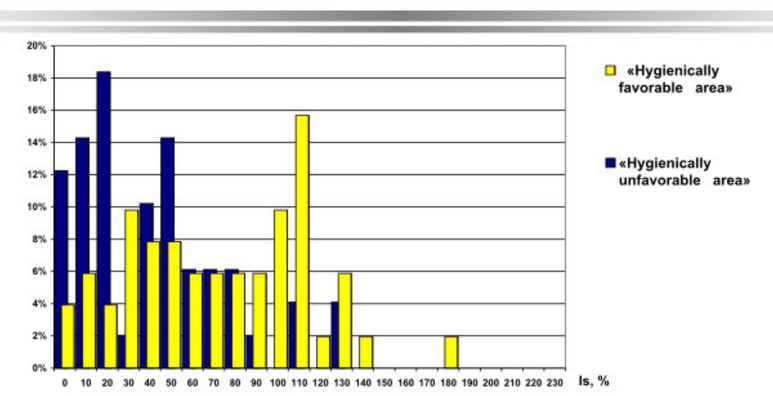

Fig.3. Frequency distributions of urine toxicity indexes, Lipetsk.

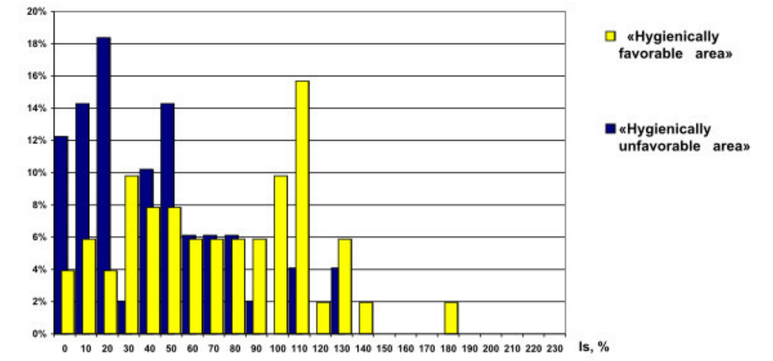

Fig.4. Frequency distributions of urine toxicity indexes, Voronezh.

Table of
AVERAGE VALUES OF URINE TOXICITY INDEXES

City	Voronezh		Lipetsk	
Area	Hygienically favorable	Hygienically unfavorable	Hygienically favorable	Hygienically unfavorable
Average value of toxicity index, I_t^S%	95.9	67.4	72.9	40.9

Average values of toxicity indexes which identify hygienically favorable and unfavorable area in Voronezh are larger than those of the corresponding groups in Lipetsk. It is evident that the urine samples taken in Voronezh are of a lower cytotoxicity as compared to the samples taken in Lipetsk. The average value of toxicity index which identifies hygienically unfavorable area in Voronezh almost coincides with the average value of toxicity index which identifies hygienically favorable area in Lipetsk. Based on the data, it is assumed that hygienic conditions in Voronezh are better than those in Lipetsk. In fact, there are two big industrial enterprises in Lipetsk – Steel Works and ore-dressing plant. In Lipetsk, the industrial pollution makes up 85% and auto pollution — 15% of total. As for Voronezh, the proportion is vice versa: the industrial pollution makes only 15% and auto pollution — 85% of total. According to the data of the Federal scientific centre of hygiene named after F. Erhisman, in hygienically unfavorable area of Lipetsk the industrial pollution makes up 87% and auto pollution— 13% of total, while in hygienically favorable area it makes up 65% and 35% correspondingly. Complex anthropogenic load on the environment in hygienically unfavorable area is twice as large as those in hygienically favorable area. Besides, the sick rate is very high in hygienically unfavorable area.

Thus, the comparison of the results and environmental data makes it evident that urine toxicity monitoring of the children's group at the age of 2-6 is a marker of hygienically favorable conditions