Shot report

ECOLOGICAL HOMEORHESIS AS THE STAGE OF MICROEVOLUTION

Dubov A.V.
State Medical Research Institute for Northern Problems, Siberian Division of Russian Academy of Medical Sciences, Krasnoyarsk, Russia.

Homeostasis as relatively dynamic constancy of organism internal environment is evolving under the influence of extreme natural and artificial factors, the moving of a population to extreme climatic zones, the introduction of new species of organic origin into biocenose, the formation and the infill of ecological niches. We are working out the concept of ecological homeorhesis in terms of bringing it to line with ecological factors of homeostasis system on the level of population, species and interspecific.

Ingenious Ch.Darvin [1] ascertained fundamental regularities of evolution process, i.e. natural selection, working for the sources of numerous hereditary differences, existent in nature.

As is often the case in science, every prominent discovery in the sphere of evolution theory uncover the depths of our ignorance. This was marked since the 1920-s when it was shown that a population is an elementary evolution unit. At the end of 1930-s the basic theses on modern microevolution theory had been formulated. Next steps of ignorance were discovered in the 1960-s in connection with the development of genetic bases of evolution [2,3,4]. Geneticists-populationists started from argumentation of evolution of separate alleles (genes) and were made certain of insufficiency of such approach, came to the necessity to study the evolution of whole gene systems [5]. And, at last in the beginning of the XXI-st century we formulated the principle of microevolution by the first time. It is based on ecological homeorhesis as associating with ecological factors of homeostasis systems on populational, specific and interspecific levels [6,7,8,9,10].

The basis of the research is the system approach. The system is the aggregate of some elements, connected with one another and regarded as a single whole in terms of function and structure [11,12]. The system microorganism- macroorganism is adaptive, i.e. it automatically changes function algorithms and/or the structure for achieving optimal state under the changes in the environment. In the given case both macroorganism and microorganism (virus) can be considered as components of adaptive system.

In natural scientific terms the macroorganism - microorganism system presents one piece with its elements being contrasts. The functioning of the system in biocenose is provided by the mechanism of distributing microorganism in the population of macroorganism [7]. The influence of the elements of the system is manifested as a struggle of opposites. As a result the whole system disappears or its components survive, being transformed or the adaptation of system components evolves (for instance, selection of naturally unreceptive populations of microorganism or naturally impaired populations of pathogen). This state should be examined as the stage of microevolution in system components or in the whole system with the formation of ecological homeorhesis in the macroorganism - microorganism system [9].

Starting mechanism in the formation of ecological homeorhesis is ecological stress [6]. It attributes to the impact of natural and artificial cataclysms, the moving to extreme territories, the introduction of new organic specimen into biocenose, the formation and filling of ecological niches. Ecological stress of different intensity can be acute (short-term and interchangeable with relative comfort) and chronic (long-term).

All kinds of stress lead to the development of different dysregulation processes, aimed at the transformation of existing homeostasis. In this respect the dysregulation of functions presents typical pathological process. These disturbances are transitory. They disappear after the elimination of pathological process and do not serve as dysregulation pathology. The last one represents the malfunction in organs and systems, which by itself becomes the reason of pathology development. Dysregulation can appear on all structural functional levels, starting with molecular, genetic, and completing with high relationships in biosystem [13] and system (mother – placenta - fetus, microorganism -

microorganism). But, reserved character of hereditary variability caused by recessive character of mutation relative to normal form of a gene does not allow fairly interrelate genotype and phenotypic manifestations [14].

In the process of the evolution of macroorganism - microorganism system the virus genes bear a resemblance to master genes. This makes easier virus reproduction or the completion of its life cycle (virus mimicry). It was ascertained that genes in the rank of viruses (Herpesviridae, Adenoviridae, Poxviridae) encode albumen, used by viruses to resist immune reactions of an organisms [15].

In high latitudes severe ecological factors influence all types of metabolism in humans [16]. This is reflected in the chemical content of internal environment (blood). An organism turns to the new level of homeostasis, which is characterized by the formation of new ecological norms of its health. On the populational level the systems of homeostasis are brought to conformity with ecological factors. The peculiarity of these changes is higher implementation of fats and lower of carbohydrates for energy needs. The role of albumen in energy metabolism noticeably grows. The need for water- and fat- soluble vitamins changes. These changes can be regarded as the development of polar (diametrically opposed) metabolic type [17] on populational level, which represents the stage in microevolution.

The association of small and large mammals provides the circulation of viruses of vernal encephalitis group under natural conditions of infection. It was determined that, the mammals are not ill with these diseases, including omsk hemorrhagic fever, including musk-rat. The animals develop virusemia, high enough to support epizootic chain. Viruses do not penetrate through hematoencephalic barrier into target organs, i.e. spinal cord and brain. In cases when they penetrate into, their reproduction is very limited and is insufficient for the development of the disease and the death of an animal. So, in epizootic chain, the provision of virus reproduction takes place as well as its preservation like species without the development of disease. In Siberia a musk-rat became an alien animal, being brought here from the USA in the 1930 – s and introduced into Siberia biocenose as a new ecological component. In the territory, previously inhabited by the musk-rat, the virus of omsk hemorrhagic fever didn’t circulate. In the terms of evolution an animal was not prepared to meet this pathogenic organism. In 1950 –s musk-rat epizootics led to the death of 92-95% population. Virulent virus was excreted from organs and tissues of spinal cord and brain in both diseased and frozen during winter dead musk-rats. In the 1960 – s nearly 50% of the musk-rat population died and in the 1970 –s in the period of epizootic, which we confirmed in the terms of virology, the death of only 4-6% of musk-rat population was registered. [19,20]. In the musk-rats, who were not ill, the virus was extracted from blood and inner organs. It was not found in spinal cord and brain or found very rarely and in low concentration [10, 20]. In hypodermic and intra-abdominal infection musk-rats didn’t possess antibodies against omsk hemorrhagic fever and other stimulators of tick-borne encephalitis complex, virus strains, secreted in the 1950 – s, severe panencephalitis was developed in animals with the death at the 7-10 day after being infected. Musk-rats, infected extraneurally (hypodermically, intra-abdominally), through mouth and nose were dead 1-3 days later. In musk-rats, infected extraneurally by omsk hemorrhagic fever virus strains, extracted in the 1960–s, the outcomes were different. Some strains started the development of encephalitis with extremities paralysis and death of the animals. Others showed only inertia and in some cases slight convulsion. Many of musk-rats recovered [18, 20]. In musk-rats, infected extraneurally with virus strains, extracted from healthy musk-rats in the 1970 – s, as a rule, there were no cases of illness or death [10, 20].

In the past measles virus circulation in isolated human populations was utterly limited. 100 – 150 and more years ago when stimulator was brought to Russian Circumpolar territories, 50-95% infant and adult inhabitants got ill and died from measles. In 1947 with almost 100% morbidity (measles) in the Extreme North there were no mortal cases caused by this disease [21, 22]. From the 1950 – s and up to vaccination period the measles morbidity in high latitudes reached 1500-4000 per 100 000 subjects, i.e. it exceeded the morbidity in middle latitudes dozens of times. But at this time not a single mortal case was revealed. The cause of the disease was very light and with further recovery [23].

In year 2000 the infection diseases, which can be eliminated by vaccine prophylaxis, were the reasons of 1 700 000 infant deaths in the world. Among them diphtheria 0.2%, whooping-cough 17.3%, measles 45.5%, yellow fever 1.8%, Jlib-infection 23.4%. The analysis of measles morbidity shows the prevalence of fatal outcomes in tropical and subtropical zones in Afro-Asian continent, 60% of them taking place in Africa, i.e. in the area with the highest air temperatures, 30% in South Eastern Asia, 10% in the East Mediterranean part. Because of vaccinal prevention against measles in these regions from 1990 to 2001, the ratio between recovering and mortal cases in the group of diseased, non-inoculated subjects remained the same. In the Extreme North the clinical cause of measles infection was light not only in native, but in alien population as well. This proves lower virulence of a virus, which circulates in high latitudes.

It is known, that under natural conditions virus circulating strains consist of more of less virulent virions. Virus virulence is caused both by the receptivity of macroorganism and the ratio (virus strain) between virulent and naturally impaired virions in population. In the process of interaction between macroorganism and microorganism in population, the last one has definite advantages in the process of adaptation and selection, because its reproduction per time unit essentially surpasses the reproduction of macroorganism [24]. At the same time virulency and pathogenicity of microorganism is caused only by its preservation as species, which is determined by the ability to be distributed in population, population flow or microorganism body. The experience of creating living vaccines against poliomyelitis, measles, rubella, parotitis and others confirmed this statement. In tissue cultures under low temperatures (indication rct_{30}) vaccine, non-virulent for humans virus strains were selected. Highly virulent populations were selected under 40-42 degrees. Probably, air temperature became one of the factors, resulting in virus strain selection with different virulence. Air temperatures in the Extreme North are very low, at the same time face and upper nasopharynx part temperature is 2 degrees lower as compared to middle latitudes. We do not have the data on nasopharynx temperature in tropical and subtropical zones.

The analysis of the obtained materials allows to come to the conclusion that under extreme ecological conditions at the present time microevolution happens both in population and in the system of microorganism-macroorganism populations. Starting mechanism of ecological homeorhesis formation is ecological stress, which induces the development of different deregulatory processes (phenol- and genotypic modifications). Deregulation is malfunction of organs and systems, which leads to the dependence from the intensity and duration of ecological stress or to adaptation or to disadaptation. The last one on the population level can cause pathology in some representatives of population or to induce selection (natural or artificial) in others. When the evolving homeostasis comes into conformity with extreme ecological factors on the population level, ecological homeorhesis is being formed, which is the stage of microevolution.

References

1. Darvin Ch. Origin of species by means of natural selection or the preservation of selected species as a result of the struggle for existence. The translation of the 6-th edition in English (1872) K.Temeryazeva.- Moscow-Leningrad,1939.

2. Shamalgauzen I.I. Cybernetic aspects of biology.- Novosibirsk, 1969.

3. Shamalgauzen I.I. Ways and patterns of evolution process. -Moscow, 1983.

4. Berg L.S. Proceedings on evolution theory. – Leningrad, 1977.-387 p.

5. Lewontin R.C. The genetic basis of evolutionary change.-New York and London, 1974.-351 p.

6. Dubov A.V. Stress and adaptation as the main links of the formation of ecological homeorhesis. Deregulation pathology of organs and systems.- Moscow, 2004.- P.151.

7. Dubov A.V. Virulence as a marker of the ecological homeorhesis in macroorganism-microorganism system. Development of international collaboration in infectious disease research.-Novosibirsk, 2004.-P.49.

8. Dubov A.V. The ecological homeorhesis as a basis of the evolutionary change. – Fundamental research.-2005.-№10.- P.77-78.

9. Dubov A.V. Deregulatory pathology in the mechanisms of ecological homeorhesis formation. Health protection and development in the North and Sibiria population.- Krasnoyarsk, 2005, Publication.4.-P.10-12.

10. Dubov A.V. Ecological homeorhesis as the basis for health development and protection in the inhabitans of Extreme North. The 13-th international congress on circumpolar health.- Novosibirsk, 2006.-P.75-76.

11. Encyclopedia of medical terms.- Moscow, 1984, publication III.- P.119.

12. Anohin P.K. The central questions in the theory of functional systems.- Moscow, 1980.

13. Kryzhanovsky J.N. Dysregulatory pathology. Pathogenesis.-2004.-P.21-29.

14. Yastrebov A.P., Makeev O.G., Izmaylov I.H. and co-authors. The study of the role of genome disturbances in the processes of the development of adaptive reactions under the influence of extreme factors on an organism. Deregulation pathology of organs and systems.- Moscow, 2004.- P.163.

15. Nosik N.N. Cytokine under virus infection.- Virusology problems.- №1.-2000.- P.4-10.

16. Panin L.E. Human homeostasis in high latitudes. The 13-th international congress on circumpolar health.- Novosibirsk, 2006.-P.13-14.

17. Panin L.E. Energy aspects of adaptation.-Leningrad: Medicine, 1978.-190 p.

18. Haritonova N.N., Leonov Y.A. Omsk hemorrhagic fever.- Novosibirsk: Science, 1978.- 222 p.

19. Gurbo R.D., Dubov A.V., Galimova E.Z. and co-authors. On the duration of epizootic of omsk hemorrhagic fever in musk-rats. The conditions of tick-borne encephalitis in Western Siberia.- Leningrad, 1974.-P.92-94.

20. Smorodintsev A.A., Dubov A.V. Tick-borne encephalitis and its prevention.- Leningrad: Medicina, 1986.- 231 p.

21. Volynskaya V.A., Dadashyan M.A. Measles.- Moscow, 1957.

22. Fadeeva L.L. Materials on the study of measles virus. Thesis for a Doctor's degree.- Moscow, 1963.

23. Dubov A.V. Virology problems in Siberia and Extreme North.- USSR Academy of Medical Sciences Bulletin.- №2.-1983.-P.87-90.

24. Efroimson V.P. Immune genetics.- Moscow: Medicina, 1971.-336 p.