

Preventive rehabilitation as a new direction of restorative medicine (development of thermodynamic health concept)

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Abstract

The fundamental position on the essence of life and health as a manifestation of the transformation of solar energy into other types of energy (thermal, mechanical, electrical, etc.) used in life processes is discussed. It is asserted that the effectiveness of intracellular energy formation as a manifestation of the function of mitochondria (the final stage of solar energy transformation) is an indicator of the body's resistance to external and internal negative influences. This makes it possible to approach a quantitative assessment of the level of health (vitality) of the individual. There is a level of energy education, above which neither endogenous risk factors nor the diseases themselves are registered. He was given a quantitative characteristic ("safe" level of health). It is proved that the output of the majority of the population from the "safe" health zone is the direct cause of the epidemic of chronic non-infectious diseases. To prevent the development of this epidemic, it is necessary to return to "safe zones" of health. This is the essence of preventive rehabilitation.

Key words: Thermodynamic concept of health, intracellular energy education, health diagnostics, epidemic of chronic non-infectious diseases, preventive rehabilitation.

Introduction

How can rehabilitation be preventive? After all, for the restoration of functions, its insufficiency is necessary, caused by different reasons. But there is a function that is not evaluated in the clinic and its condition is not taken into account when solving health problems. It is about the function of energy generation, i.e. Laws of thermodynamics in a living organism.

Thermodynamics is the movement of energy. Energy controls everything that happens in the world [7, etc.]. Its laws determine the existence of the universe, our Planet, all living and nonliving. And, of course, Man. Do we take into account in due measure the fact that man is an open thermodynamic system functioning at the expense of solar energy, and his condition is largely determined by the laws of thermodynamics? The age-old experience of practical health care gives

a negative answer to this question. And this is understandable, because the direct application of thermodynamic laws to the analysis of life phenomena leads to a direct contradiction: the evolution of living systems occurs in the direction opposite to that indicated by the second law of thermodynamics (instead of system degradation - energy growth and organization of the system). Consequently, according to the ideas of classical thermodynamics, life as a stable phenomenon should not exist. But the very fact of existence and development of life convincingly demonstrates the incorrectness of conclusions of this kind. It was required to develop a new field of thermodynamics - nonequilibrium thermodynamics (I. Prigogine), on the basis of which it was possible to introduce thermodynamic criteria for the evolution of open systems. In application to living systems, the openness of which is one of the most important

properties, these criteria determine the stability of a stationary nonequilibrium state (rather than equilibrium - the analog of death!), In which the rate of entropy production and, consequently, the energy dissipation is minimal.

Physicists and mechanics called energy “the queen of the world”, and entropy - its “shadow.” The concept of entropy has a dual nature. On the one hand, entropy characterizes the “useless” heat dissipated by the system, and on the other hand it is a measure of orderliness (with increasing entropy disorder-chaos increases). So in biology, where the orderliness of structures in the process of evolution for some reason increases, more attention was paid to entropy than energy. “The Queen of the World” - the energy was in the shadow of its own “shadow” - entropy. Much has been said about the negative ordering entropy inherent in living organisms. Even sunlight was preferred as a “powerful source of negative entropy,” and not as a flow of energy [20]. Meanwhile, for the existence of any stationary state of an open system, a flow of free energy from the outside is necessary, and not a negative entropy (negentropy) flow into the system, as was implied by Schrodinger’s conclusion, most often mentioned in the literature.

With the evolution of living systems, an increasingly important role is played by processes aimed at improving energy efficiency. “Raising energy of life” is one of the main evolutionary changes. Researchers [10, etc.] came to the conclusion that the progressive evolution of the living is associated with the improvement of intracellular respiration, in other words - the formation of energy. In the process of evolution, the higher primates took the upper step on the bioenergetic ladder of evolution.

E. Bauer pointed out the most clearly the applicability of the second law of thermodynamics to living systems. He formulated the principle of “steady disequilibrium”: it is the continuous

thermodynamic imbalance - the cardinal difference between the living and the lifeless. Proceeding from this, the author formulated The basic law of biology: “All and only living systems are never in equilibrium and perform at their own free energy constantly work against the balance required by the laws of physics and chemistry” [6, p. 32].

What does this mean in practice? And in practice this means that by estimating the reserve of “free energy” of the living system (including the human body) quantitatively, we can make a valid conclusion about its stability (viability) in specific environmental conditions [5]. It was to this problem that the author devoted 35 years of his life. As a result, data were obtained for solving the most important problems of practical public health.

Assessment of health by direct indicators

The problem of individual health studies medicine more than two thousand years. The result of these studies poetically reflected R. Doll [12]: “There have been many attempts to build a scale of positive health, but so far the measurement of health remains the same illusion as the measurement of happiness, beauty and love.” And this is logical, because “well-being” (a key word in the WHO definition of health) is the same abstract-logical category as happiness and beauty, and they can not be characterized by quantitative criteria. To solve the problem, it is necessary to depart from the criterion proposed by WHO, and to propose a new - real - criterion of health. At the same time, for those who have thoroughly investigated the problem, it is obvious that many aspects of health dictate the necessity of narrowing this category to the limits that give an opportunity to give an operational definition of health. Operational definition is a scientifically necessary condition for translating a general abstract judgment into precisely delineated realities that

can be reproducibly identified. Such a definition should contain rules describing the way in which the state of the object that can be controlled can be standardly characterized. How to define it?

In the years of existence of the USSR, we took part in studies on a closed subject, which today can not be repeated for understandable reasons (the timing of the onset of hypoxic coma in divers with breathing hypoxic mixture, physical performance before and after massive blood loss, the dynamics of the professional performance of operators in a multi-month effects of a complex of unfavorable environmental factors, etc.). An analysis of the results of these studies showed that there is a general sign of the stability of the human body to adverse effects - the energy potential of the biosystem (which corresponds to the second law of thermodynamics). And the more the formation of energy per unit of body weight, the more effectively the biological survival function is carried out. Permanent energy education is the main condition for the existence of a living organism. Thus, per 1g of the human body, 3 g of ATP daily break up and re-synthesize.

Thus, the leading criterion for the existence of the biosystem, intracellular energy production, ensuring viability. It is this criterion that can be used as the basis for a quantitative assessment of physical health by direct indicators. At the organism level, the energy potential of the biosystem can be characterized by the maximum possibilities of aerobic energy generation - the maximum consumption of oxygen (MCO, ml / kg of mass / min), which reflects the state of the mitochondrial function, and its increase is accompanied by systemic reactions of the organism - expansion of the functional reserve and economization of functions at rest and with metered exposures. The system of rapid assessment of the level of viability (aerobic potential) developed by us on this basis may well act as a quantitative criterion of the level

of somatic health [2,5]. The simplest indices of functions are used that characterize the functional reserve (power and respiratory indices) and the economization of functions (the "Robinson index" and the recovery time of the pulse rate after 20 sit-ups in 30 s). The weight-growth index is also included in the diagnostic system. The indicators are ranked, each grade is assigned a score, and the score is characterized by the level of health (vitality). It is established that the sum of scores has a high correlation coefficient with the maximum oxygen consumption (about 0.8). There are 5 levels of health.

It is obvious that the level of physical health should reflect a simple pattern: more health - less illness, and vice versa. And this is shown in our numerous studies. Thus, the frequency of detection of chronic physical illness during outpatient examination of industrial plant workers is reduced from 94% in the group with a low level of physical health to 1-2% in individuals in groups with high and above average health.

Keteyian et al. [14] showed that each increase in the specific MCO of 1 ml is accompanied by a decrease in the risk of death in men and women with ischemic heart disease by 15%. Myers et al. [17] note that an increase in maximal aerobic capacity by 1 MET is accompanied by an increase in survival of men with cardiovascular diseases by 12%.

Therefore, the MCO / kg / min really reflects the level of health and can serve as an integral criterion for viability and biological age. The results of our studies demonstrate the possibility of obtaining indirect information about this indicator using simple methodological approaches, which brings it closer to implementation in the primary health care sector.

The problem of fighting the epidemic of CND

The biggest problem of modern health care is chronic non-infectious diseases (CND). In

developed countries, they act as a cause in more than 80% of all deaths. Particularly high is the share of deaths from diseases of the cardiovascular system (in Ukraine up to 67%), while there is a constant increase in this indicator. State and international programs (for example, CINDI) have not changed the situation. It turned out that the hope to improve the health of the population due to the concept of risk factors is illusory, because fighting with them does not reduce the number of cases (we are talking about endogenous risk factors). This concept answers the question “how” and does not answer the question “why”. More and more works appear, in which there is doubt about the ability of traditional preventive approaches to influence overall mortality [9, 18, etc.]. Classical risk factors in some situations may act as risk indicators, predicting the onset of the disease, but their correction does not necessarily improve the prognosis. In addition, there is the phenomenon of “pumping mortality” [9], when the reduction in mortality from some diseases is accompanied by an increase in mortality from others, without giving a result in terms of increasing life expectancy.

In order to assess the evidence of the statement, according to which multifactor prevention of CND aimed at correction of traditional risk factors, provides a reduction in overall mortality, I.A. Gundarov et al. [9] conducted a fundamental study, which is based on the analysis of the effectiveness of the most known preventive programs in terms of evidence-based medicine.

The material is based on the results of major Russian and foreign multifactorial programs that constitute the “gold” fund for the epidemiology of CND and medical prevention. The analysis showed that out of 23 programs in only one overall mortality decreased, in three increased, in the remaining the difference was unreliable. Thus, the null hypothesis about the ability of traditional

multifactorial prophylaxis of CND to influence overall mortality has not been confirmed.

It should be emphasized that mortality did not decrease even with a marked decrease in risk factors. This suggests that they are indeed risk indicators that help predict an unfavorable situation, but minimizing (eliminating) them does not improve the prognosis. The participants in the prevention programs state: “Studies of multifactorial primary prevention for reducing cardiovascular diseases gave rise to disappointing results ... differences in total and coronary mortality between intervention and control groups were reduced ...” [16]. It is concluded that this approach is premature for practical health care [15]. A similar conclusion was reached by foreign researchers in the analysis of later multifactorial prophylactic programs, published in the most authoritative from the point of view of evidence-based medicine Cochran Review [13]. The validity of the fear is confirmed by the increase in mortality at the start of prevention, shown in a number of reviewed projects, which means an increase in the number of lost life years in intervention groups.

The lack of convincing evidence of the effectiveness of multifactorial prophylaxis programs for CND in reducing cardiovascular and general mortality puts on the agenda the question of changing the existing paradigm of medical prevention and developing new approaches to health promotion. It is required to develop an innovative organizational and functional model for preventing excess mortality from CND, which can be based on the strategy of individual mass prophylaxis, based on the principles of measuring human health reserves [3,9].

In the process of evolution, the efficiency of intracellular respiration is improved [10], i.e. This function has for the species *Homo Sapiens* an evolutionarily conditioned threshold. We

called it a “safe” level of health (SLH) and gave it a quantitative characteristic [2,5].

Above SLH, neither endogenous risk factors for chronic non-infectious diseases (cardiovascular, malignant, endocrine, etc.) nor the diseases themselves are registered.

Under the influence of negative environmental factors, unhealthy lifestyle, aging, etc., the efficiency of intracellular energy production decreases. In accordance with the thermodynamic concept of health and prevention [1], the output of its effectiveness beyond the SLH is accompanied by the phenomenon of “self-development” of the pathological process and is the primary cause of the epidemic of CND (energy loss-entropy growth-chaos of functions-pathology). With the spread of such changes in the scale of the population, in addition to the epidemic of CND, the rate of aging accelerates, reproductive function suffers, physical and psychophysical qualities decrease, etc.

The first reaction of the body to a change in intracellular homeostasis, primarily the lack of ATP, is an increase in blood pressure [8]. Thus, the fight against endogenous risk factors for the development of CND without increasing the energy potential of the organism to the level caused by evolution (SLH) is ineffective. Studies by Myers J. [17] confirmed our hypothesis that low rates of aerobic capacity are a more potent predictor of overall mortality and cardiovascular morbidity than other cardiovascular risk factors, such as hypertension, smoking, hyperlipidemia and diabetes mellitus. Aspenes S. a.o. [11] in the studies of a healthy Norwegian population confirmed our data on the presence of SLH, showing that each decrease of the MCO by 5 ml / min / kg below the SLH increases the risk of cardiovascular pathology by 56%. By now, a meta-analysis of publications on this problem has appeared, which confirms the indicated regularities [19].

Thus, the morbidity and mortality of the

modern population is mainly due to a decrease in intracellular energy production (mitochondrial function), and CND is only a consequence of this process.

What is waiting for humanity next?

We believe that humanity faces a problem whose significance is not yet sufficiently understood by the public or science - biological degradation of the species *Homo sapiens*. It is manifested by the accelerated rate of aging, the population decrease in the “amount” of health (viability), the epidemic of chronic non-infectious diseases, polymorbidity, decreased reproductive function, the birth of weakened offspring, etc. All this is a consequence of a decrease in the function of mitochondria and a decrease in the stability of the nonequilibrium thermodynamic system (4).

Our research has convincingly shown that people fall ill and die prematurely from a loss of health, and chronic non-infectious diseases are a consequence of a decrease in the potential for health (more health - less illness, and vice versa). Is it possible to prevent such a sad development of events? Of course you can, if you constantly monitor the level of energy potential of the biosystem. And in time to take measures to increase it. In order to prevent the development of chronic non-communicable diseases, it is necessary to carry out a complex of measures to return the individual to a “safe zone” of health. Thus, we are talking about the restoration of the function of intracellular energy production, which in turn is the prevention of CND. Hence - “preventive rehabilitation”.

With all the diversity of living elements, there are always three main components: the source of energy for the provision of life processes; Delivery to organs and tissues of fuel and oxidizer for the “biological furnace”, as well as “building material” for organs and tissues, and waste disposal - products of vital activity. And all this is managed

by a complex regulatory center, which in turn consists of the nervous system, the endocrine regulation system and immunity. This is the simplest algorithm for the formation of a system of preventive rehabilitation.

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