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Mathematical Modeling of Restoration of the Living System's Function

Our large experience of treatment patients in coma - apallic syndrome (AS) and the analysis of restoration of their functions in the rehabilitation process made us interested in the aspect of estimation of reserve potential of the human organism and capacity of self-restoration with numerous and deep damages in the brain, multi-injuries. Our considerations we tried to present in the next models from minimum capability to maximum adaptation.

A minimal model. The human body could be an initial stage for modeling the living system, which is structurally formed, has all organs but not all are functioning. In most cases very this model could be as a standard for modeling any comatose states. Our results have shown that most patients with AS had satisfactory blood, urine tests etc. It says that a living organism was statically preserved, however from dynamic positions it was not able to function adequately. This means that considering the simple model we have a structurally preserved body, but is not capable to function - a body in shock (coma with expressed disbalance in functioning of vitally important organs).

A chaotic model. Now we will complicate the model - a body start functioning as a chaotic system, organs and systems chaotically work in their autonomous background mode. This model reminds an orchestra that keeps training without a bandleader before a concert. Chaos of sounds of different instruments could be heard. Sometimes occasionally they fall together in euphony. The model of initial resuscitation can be considered by the example of an organism which begins to «wake up » from shock.

A model of the control decentralization. The next model is a variant of resuscitation, there is a start for rhythmic work of the heart and breathing, however there are no minimum signs of the brain functioning, which clinically are shown by changing of phases «sleep-cheerfulness». That is so-called heavy artillery (heart, breathing) started in the automatic mode, however the leading organ – the brain is not able to restore its higher hierarchical function. The model can be associated with the state of apallic syndrome.

Thus, 3 models - coma, resuscitation and apallic syndrome can be in the basis of the process of mathematical modeling, as the most primitive, and the next models of «little» and «large» consciousness, self-service, social and professional adaptation describe more complicated levels of the human organism's functioning.

Parameters of the living system model could be divided into parameters of external dynamics (visual and clinical) and internal dynamics (instrumental).

There are such variants of identification of parameters for the living system model:

1. visual
2. clinical
3. instrumental.

In our clinical practice the mentioned approach gave significant results and enabled to come to such conclusions.

All living organisms function by principle of stable balance of two mutually opposite vectors of influence:

- arteriovenous balance
- harmonic development - disproportionate ontogenesis
- excitation-braking and etc.

2. According to laws of mathematical modeling living organisms exist as integral with precise systemic hierarchies. Violation of subordination of one or another system in the brain could result in

re-profiling of the size and vector of excitation, violation of processes of synchronization of all involved links.

3. The living system functions as a hybrid system at combination and simultaneous existence of two subsystems - mechanical and electronic control with their partial mutual submission. The mechanical system is more lasting in comparison with the hybrid one.

4. Therefore lack of pathological paroxysms, diminishing of their frequency and duration on a background of harmonic development of personality of a patient and balancing of regulator systems of various vectors should be considered as an end goal in treatment of patients of psychoneurological type. Paradoxical reactions could be an exception, they said about disbalance or failure in the system of reacting and one should consider them and foreseen before the treatment. The paradoxical reactions of a disbalanced organism can result in considerable worsening of the patient's state in comparison with the background ill state.

5. A concentration of anticonvulsant drugs in an elbow vein can considerably differ from the concentration of these drugs in the brain areas, especially at presence of the phenomenon of the arteriovenous shunting in cavernous or in other sinuses of the brain.

6. Stress reactions, which are fixed in the brain and were not neutralized during psychotherapy sessions, can be a trigger of frightful dreams resulting in a nightly convulsive attack.

7. Today the complex objectivization of the state of all systems in the brain (exactly the brain!) is urgently required under control of up-to-date diagnostic equipment for adequate and correct tactics of treatment patients with convulsive reactions, preferably from the phase of the disease debut.

Therefore, "losing" of consciousness of patients with convulsive reactions should be considered as pathologically sanogenic, which means that the organism's attempts to find a way out of a non-standard situation or just to inform about disorders in the living organism. The hybrid living system in functioning provides with the emergency changing to the system of the hard protective re-start of the organism without interference of the patient himself. However it doesn't mean that it is able to overcome all breakages in the organism. Not "harm the brain and help it to control the situation" - such approach might be in the base of present tendencies in treatment of patients with convulsive attacks, unlike the simple blocking of visual convulsive reactions by high doses of anticonvulsants.

Thus, understanding of peculiar features of the living system re-start in a damaged organism enables to simulate states, to foresee a patient's state, possible rehabilitation and a level of restoration of the lost functions of the organism. In our clinical practice the mentioned approach allowed to make sure, that there are not any incurable states in medicine, and there is a problem of using mathematical modeling in questions of the health restoration.
