



YEVROSIYO PEDIATRIYA AXBOROTNOMASI **ЕВРАЗИЙСКИЙ ВЕСТНИК ПЕДИАТРИИ**

TIBBIY ILMIY-INNOVATSION JURNAL
МЕДИЦИНСКИЙ НАУЧНО-ИННОВАЦИОННЫЙ ЖУРНАЛ



ISSN 2181-1954
ESSN 2181-1962

3(18)
2023

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ЕВРОСИЁ ПЕДИАТРИЯ АХБОРОТНОМАСИ
ЕВРАЗИЙСКИЙ ВЕСТНИК ПЕДИАТРИИ

Тиббий илмий-инновацион журнал
 Медицинский научно-инновационный журнал

Учредители:
 Ташкентский педиатрический медицинский институт
 Санкт-Петербургский государственный педиатрический медицинский университет

Зарегистрирован агентством информации и массовых коммуникаций при Администрации Президента Республики Узбекистан 08.05. 2019 г.
 Свидетельство №1023
 Журнал с 01.09. 2019 года включен в список иностранных журналов ВАК Республики Узбекистан. Протокол № 268/7 от 30.08. 2019 года.

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3(18) 2023

UDK:616.89–008.441.44–05

**HISTORY AND PROSPECTS FOR THE DEVELOPMENT OF FORENSIC SUICIDE
ASSESSMENT**

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According to WHO, suicide is among the leading causes of death in many countries. In Russia, the average level of completed suicides is 39.7 cases per 100 thousand people, which is a high figure (2001). The problem of suicide is analyzed in numerous studies by domestic and foreign authors. Suicide is presented as a complex biosocial phenomenon, the result of the influence on the personality of various cultural, social, psychological and clinical factors that have a destructive impact on its adaptation mechanisms (M.A. Lapitsky, S.V. Vaulin, 2000). A number of works by forensic psychiatrists are devoted to a retrospective assessment of the mental state of suicide victims (G.V. Zenevich, 1938; Y.M. Kalashnik, 1963-1971; I.A. Mizrukhin and S.M. Livshits, 1965; A.L. Russinov, 1970; P.P. Lipanov, 1971; V.V. Gorinov, 1994-1996; T.P. Pechernikova, 1996-1998; A.A. Tkachenko, 2001-2002, etc.).

At the same time, the authors' opinion regarding the main subject of expert research when conducting post-mortem SPE "on the fact of suicide" is ambiguous. Ya.M. Kalashnik and A.A. Russinov believed that experts should assess the mental state of suicide victims at the time of suicide; other authors believe that - in the period preceding the suicide. At the same time, judicial investigative bodies often raise before experts the question of the ability of suicidal people, specifically when committing suicide, to "realize the actual nature of their actions and direct them," and use the formula of

sanity (sometimes legal capacity), despite also the fact that Suicide is not a criminal offense.

There are problems that attract the attention of researchers not only because of their objective significance, but also because of their direct relationship to the field of "human studies." There are many such questions, but in modern conditions, in our opinion, the problems of human adaptation to new economic, social, political and spiritual conditions become particularly relevant.

Modern society is increasingly defined as risky, which is associated with the variety of transformation processes occurring simultaneously in it. This situation requires building a system of examination of any reconstructions and innovations in non-economic spheres, since miscalculations in assessing social risk and the lack of mechanisms for insuring society from its consequences lead not to man-made disasters, but to such conditions as "value vacuum", "collapse of the nation", "demographic hole", etc. Understanding that it is impossible to avoid such processes in the conditions of large-scale transformations in an absolute sense, it is still necessary to work to reduce the negative consequences and accumulate a certain resource (ideological, material, etc.) to neutralize them.

But it is when the danger is not recognized that it poses the greatest threat to those affected by it and who lose sight of it.

The current demographic situation in the Russian Federation is largely determined by the socio-economic processes that took place in the 20th century. In the second half of the last century, 2-2.5 million children were born annually in the Russian Federation, and 1-1.5 million people died.

The life expectancy of citizens was constantly increasing and approaching the indicators of European countries. Average life expectancy in 1990-1991 was 68 years.

In 1990-1991, the prevalence of suicide was 26.5 cases per 100 thousand population, which was only slightly higher than the WHO critical level. Since 1992, a pronounced increase in the frequency of suicides began, reaching 41 cases per 100 thousand population in 1994-1995 (an increase of 1.6 times compared to 1990).

In 1996-1998, the frequency of suicides gradually decreased. However, by 2000, their level had risen sharply again to 39 cases per 100 thousand. Only in 2002 did a gradual decline in the suicide rate begin. This dynamics reflects the changes in the social situation taking place in the country.

In 2006, Russia came in second place in the world, after Lithuania, in terms of suicide rates, said Boris Polozhy, head of the department of environmental and social problems at the Serbsky State Scientific Center for Social and Forensic Psychiatry. According to the expert, in our country there were 36.1 cases of suicide per 100 thousand inhabitants, in Moscow this figure was 11, in St. Petersburg- 17.8.

Experts have also identified about 800 reasons why people voluntarily decide to die. True, in more than 40% of cases, the cause of suicide remains unknown. Fear of punishment (19%), mental illness (18%) and depression (18%) prevail among those identified. Passions, financial losses, boredom, and physical ailments all together account for no more than 10% of

life. Psychologists identify a connection between suicide and loss of social status (King Lear complex).

The highest rate of suicide is observed among alcoholics, drug addicts, disabled and mentally ill people. The affected category includes discharged servicemen, demobilized officers and prisoners.

Suicide is a very complex and multifaceted phenomenon of a person, which is determined by many reasons and situations that sometimes contradict each other. Suicide is a serious public health and mental health problem in particular.

According to WHO, "among the CIS countries, Kazakhstan, Turkmenistan, and the Russian Federation continue to occupy a strong place among the countries with a high rate of suicide¹". The suicide rate among young people has tripled in the last decade. Every year in Russia, every twelfth youth between the ages of 15 and 19 attempts suicide; the rate of suicide among young people in our country is 20 per 100,000 population, which is 2.7 times higher than the world rate.

There are many structures in the world that deal with suicide problems. The Los Angeles Center for Suicide Research and Prevention is the most famous. According to statistics, suicide among drug addicts is one of the highest: 178 people per 100,000 people.

The high prevalence of heroin addiction in Central Asia determines the need for further study of the characteristics of clinical symptoms and therapy of this pathology. It is recognized by a large number of researchers that the effectiveness of heroin addiction therapy is quite low. The results of heroin addiction therapy determine a relatively low percentage of long-term remissions- no more than 10-15% of patients. In connection with this situation, the search for modern methods and means of heroin addiction therapy is extremely urgent.

The confirmation of the existence of the problem of combined pathology (addictive and mental disorders), the large number of cases of combined pathology, the absence of a unified approach to the qualification and therapy of such patients, without a doubt, determine the essence of studying the problem of the combination of mental disorders with the consumption of psychoactive substances as extremely urgent.

Often, a drug addict consciously uses an excessive amount of drugs, in the jargon, gives himself a "golden injection" and dies.

Even more frightening is that he must always run and find money to buy drugs later, or he feels internally malformed. An addict does not suffer from abstinence syndrome.

The analysis of published scientific literature shows that at the current stage of the development of science in our country, there is a tendency to study the relationship between signs and symbols that describe various constitutional and personality-related aspects of individuality. One of the important tasks of modern scientific theory and practice is the interest in determining the characteristics of various systems of the organism, the study of the nature of inter-systemic connections at the constitutional and psychological level in the structure of the individual.

Scientists have studied the psychological landscape of a number of diseases. However, due to the inherent difficulties in describing the psychological determinants of certain diseases, it is considered that these works have not been completed.

To determine the risk of suicide, a structured questionnaire is often used to determine suicidal thoughts. However, this is not always possible, so a simple study that objectively shows the risk of suicide is needed. It is necessary to find a biomarker for

acquisition and analysis. Conducting biochemistry and functional MRI of the brain in each and every person is considered a very expensive procedure, a "simpler" diagnostic method is needed. Blood and urine analysis are suitable for this role. These fluids contain a large number of substances that characterize the metabolism of various organs and tissues.

At first glance, the idea of diagnosing a mental disorder based on a blood test seems strange. If an infection or a myocardial infarction can be diagnosed by a blood test, what can prevent a suicidal tendency using the same method?

In depression, the amount of monoamines (serotonin and noradrenaline) in MAT decreases: neurotransmitters do not enter the synaptic cleft in sufficient quantities. Depression leads to fear and insomnia (in the case of serotonin deficiency) or decreased concentration and lethargy (in the case of noradrenaline deficiency).

Data on the metabolic characteristics of the body of suicide victims began to be collected in the late 70s of the XX century, and some of the observations were related to the metabolism of noradrenaline. It was found that the concentration of 3-methoxy-4-hydroxyphenylglycol (metabolite of noradrenaline) in the blood and urine of suicidal people is lower than in patients without suicidal attempts.

But the concentration of this metabolite, on the contrary, increased in suicide cases in patients with personality disorders. Such a feature makes it difficult to determine the risk of suicide, because it requires taking into account additional information.

The researchers then focused on serotonin (5-hydroxytryptamine, 5-HT). This monoamine not only works in the nervous system (including the response to the feeling of satisfaction), but is also important in the blood clotting system. Serotonin levels in blood plasma

and platelets were significantly lower in depressed patients who committed suicide. Interestingly, platelet count was also found to be associated with suicide.

Israeli scientists found that the number of platelets in depressed suicide patients was 20% higher than in depressed patients who did not commit suicide. Serotonin stored in platelets is necessary for normal blood clotting, and the body compensates for its deficiency by forming blood platelets. This is confirmed by the detection of disorders in the activity of the serotonin transmitter and the enzyme responsible for its inclusion in platelets of suicide victims.

This affinity between brain serotonin systems and platelets is explained by the fact that their protein-5-NT transporter and capping enzyme - is structurally similar in blood platelets and neurons and is encoded by the same gene- chromosome 17 gene. Because platelet counts can vary for many reasons, this marker may not be specific enough to assess suicidal tendencies.

In parallel with the study of serotonin metabolism, scientists studied the receptors of this neurotransmitter, which are observed not only in the central nervous system, but also in the gastrointestinal tract, blood vessel walls, and other structures. There are 15 types of 5-NT-receptors, which make up 7 families, but only 5-NT2A is recorded in platelets. The amount of receptors can be determined by radioligand analysis method. Cells suspected of having receptors of interest are treated with a radioactive target using a special substance. The target substance "sticks" to them, and the excess of the substance is removed. Radioactivity from molecules attached to receptors is then measured. The higher its speed, the more target substance remains in the cells, which means the more receptors we are looking for.

It was found that the expression of 5-NT2A-receptors in the brain and platelets was similar, and they

were also matched in terms of metabolic parameters. Therefore, the study of receptors in the periphery, in blood cells, can provide reliable information about the amount of receptors in MAT. The number of platelet 5-NT2A-receptors was found to be higher in people who committed suicide than in people who did not commit suicide, regardless of the disease that led to this act. Later, it was found that there is a correlation between suicidal behavior and higher levels of expression of 5-NT2A-receptors in the hippocampus in the prefrontal cortex.

The amount of 5-NT2A-receptors in platelets became one of the first real genetic markers of suicide risk. The relationship between neurons, which are complex in structure and function, with cells without nuclei in the blood, reminds us of the high level of integration of all processes in our body.

A more specific substance that can be detected in the "suicide analysis" is a protein called "brain-derived neurotrophic factor" (BDNF). BDNF is a substance that controls structural and synaptic plasticity, nerve regeneration, structural integration of neurons, and synthesis of neurotransmitters. As mentioned above, people who suffer from depression often commit suicide. In depression, the amount of BDNF decreases and neuroplasticity decreases, the complete connections between the frontal cortex and other areas that control human social behavior are disrupted. That is, the brain loses the ability to fully respond to external signals. When antidepressants are used, BDNF levels increase, and brain activity returns to a more or less normal mode. During the study of brain tissue of individuals who committed suicide, it was found that the concentration of BDNF decreased in the prefrontal cortex and hippocampus. An increase in the amount of 5-NT2A-receptors is determined in the same sections of the brain of people who commit suicide. A decrease in

the amount of BDNF in the brain also leads to a decrease in its concentration in the blood.

Another potential marker of suicidal risk was reported in a 2013 study published in the Journal of Affective Disorders. The authors considered the clinical and demographic characteristics of 100 patients with depression. All participants of the study were tested for suicidal tendencies during 12 weeks. In addition, the level of methylation of the promoter region of the BDNF gene was determined in each patient (methylation usually blocks gene expression). It was found that the level of methylation was higher in individuals who committed suicide and in individuals who expressed suicidal tendencies during treatment.

Until now, there has been talk about specific molecular changes related to brain activity. In cases of suicidal attempts, indicators of serotonin system activity and BDNF synthesis show changes in the activity of the prefrontal sections of the cerebral cortex and the hippocampus. Perhaps, the disturbances in the biochemical status reflect the disruption of the functional connection between these parts of the brain. The hippocampus forms negative experiences, it serves as a background for depression and supports it. An emotional problem requires a solution, and the prefrontal cortex, which performs the functions of forecasting and planning, cannot find this solution. It seems that there is no way for a person to get out of a difficult life situation, which manifests itself in the form of broken connections for the brain. It is this helplessness that leads people to commit suicide, both from a neurobiological point of view and from a psychological point of view. Dysfunction of the prefrontal cortex, which is manifested in impaired planning of actions and a decrease in their control, in patients with high suicidal risk with schizophrenia, confirms this.

In addition to narrow, "brain-related" biomarkers, when assessing suicidal risk, it is also possible to determine the general mobilization response of the body- indicators that indicate stress. In the second half of the 20th century, scientists focused on the activation of the hypothalamus-pituitary-adrenal system (HGBT) in mental disorders. Members of the GGBT are closely related. The hypothalamus secretes the peptide hormone corticoliberin, which increases the secretion of adrenocorticotrophic hormone (ACTG). An increase in the amount of ACTG increases the secretion of cortisone- a stress hormone. In addition to the described direct relationships, this system also has a reverse situation, a unique stress-inhibiting system - an increase in the concentration of one hormone reduces the secretion of its predecessor.

Autopsies of suicide victims revealed enlargement of the adrenal cortex, and high concentrations of corticoliberin were noted in the cerebrospinal fluid. Because this hormone is directly related to anxiety disorders, drugs that modulate corticoliberin receptor activity are currently being tested.

A number of scientists have also studied the correlation of myoglobin levels with suicide.

Myoglobin is an iron-storing protein that is stored in skeletal muscle cells and myocardium, providing them with oxygen, which gives them the power to contract.

During the normal functioning of the body, the content of myoglobin in the blood is so low that it cannot be determined by laboratory methods. An increase in its concentration in the blood occurs when skeletal muscles and myocardium (heart muscle) are damaged. In 85% of patients with acute myocardial infarction, an increase in the level of myoglobin is observed for 2-3 hours after the onset of pain and persists for 2-3 days (it remains longer

in the case of an aggravated infarction). It is important to note that repeated increase in the level of myoglobin in the patient's blood after the indicator has normalized, without a doubt indicates the expansion of the infarct area and the recurrence of the disease. In addition to acute myocardial infarction, a significant increase in the level of myoglobin in the blood is observed in extensive muscle injuries, long-term pressure syndrome, severe electric shock. The myoglobin molecule is formed by a single polypeptide chain and heme containing iron, and is similar in structure and function to blood hemoglobin. Myoglobin is a single polypeptide chain, consisting of 153 amino acids with a molecular mass of 17 kDa, and is structurally identical to the β -chain of hemoglobin. Protein is found in muscle tissue. Myoglobin has a greater affinity for oxygen than hemoglobin. This property of myoglobin ensures the function of storing oxygen in the muscle cell and using it only when the partial pressure of O₂ in the muscle decreases significantly (to the level of 1-2 mm Hg).

Myoglobin binds oxygen (oxymyoglobin appears) and is its main supplier for skeletal muscles. In hypoxia (for example, during intense physical exertion), oxygen is released from the complex with myoglobin and enters the mitochondria of myocytes, where ATP synthesis takes place. Myoglobin is excreted unchanged in the urine, so its concentration also depends on the functions of the kidneys. In any injury, necrosis, lysis of skeletal muscles or myocardial tissue, myoglobin enters the blood. The expression level of hypermyoglobinemia in myocardial infarction is directly related to the size of the necrosis center. It is one of the earliest markers of myocardial infarction (it is detected only 2 hours after the attack, the concentration can increase by 10 times), it is assumed that its rapid entry into the blood is related to relatively small molecules, which explains its rapid removal from the blood through the kidneys.

Damage to muscle cells causes it to be released quickly and enter the bloodstream due to its small size.

Myocardial necrosis creates conditions for increasing not only the release of enzymes into the blood, but also the release of other myocyte contents, including myoglobin. The diagnostic test is based on the determination of myoglobin content in the blood, which under normal conditions does not exceed 85 ng/ml, and may increase to 1000-1500 ng/ml and more in case of myocardial infarction. The small molecular mass allows myoglobin to easily pass through the glomerular membrane of the kidneys, which leads to a rapid decrease in its concentration in the blood plasma.

Free myoglobin is a biological marker of impaired muscle cell membrane permeability and has toxic properties by itself. The most clearly expressed damaging effect of free myoglobin on vascular endothelium and epithelia of the proximal tubules of the kidneys is described in the vasoconstrictor effect of myoglobin. As mentioned above, myoglobin is stored in red muscles. The myoglobin depot (Mb) in the myocardium is the oxygen reserve for the heart. Mb composition depends on muscle activity. The average content of myoglobin is 0.3% of body weight (5). Mb, like hemoglobin (N), has the property of combining with oxygen (oxymyoglobin), with carbon oxide (carboxymyoglobin), and can be oxidized and regenerated to metmyoglobin.

In forensic practice, when myocardial infarction is suspected, the concentration of myoglobin in blood serum and urine is determined to confirm the diagnosis of electrical injury, in positional pressure syndrome, in toxic injuries (1,3,4,5). The normal content of myoglobin in blood serum and urine is up to 80 ng/ml, with 160 ng/ml being the upper limit of normal (4). A.F. According to Kinle (2002), myoglobin should not normally be

present in urine, the norm in the blood of corpses is 0.006-0.01 g/l.

According to the literature, in primary myoglobinuria, myoglobin enters the urine after 2-24 hours and is detected for 2-3 days. In traumatic myoglobinuria, myoglobin enters the blood and urine in large quantities at the same time, acute kidney failure develops. In muscle tissue ischemia, a small amount of myoglobin is detected in the urine, no changes are observed in the kidneys. Myoglobinemia is of great importance in the diagnosis of acute myocardial infarction, although an increase in myoglobin level in the blood may also indicate skeletal muscle damage. In acute myocardial infarction, the content of myoglobin in the blood increases to a discriminatory level (80-200 ng/ml) 4-6 hours after an anginal attack. Usually, myoglobin level in the blood increases 10-13 hours after an acute myocardial infarction, and returns to normal after 24-38 hours.

Solving issues of thanatogenesis in mild atherosclerotic damage of heart vessels and alcoholic cardiomyopathy (AKMP) in forensic practice creates certain difficulties.

The dexamethasone test has also been used to assess suicidal risk. The patient takes 1 mg of the glucocorticoid dexamethasone before going to bed at night, after which the patient's individual cortisone levels are determined for several hours. When taking dexamethasone, feedback mechanisms are activated: due to the increase in the concentration of glucocorticoids, the amount of secretion of corticosteroid and ACTH decreases. As a result, the concentration of cortisone should decrease. In this situation, the body cannot distinguish much - cortisone and dexamethasone are "the same" for it. If the concentration of cortisone decreases, the test is negative in the experiment, otherwise it is concluded that the

activity of GGBT is increased. In patients at high suicidal risk, the dexamethasone test was often positive. This indicates that the GGBT is activated in depression and that the body is in a state of stress. Unfortunately, the diagnostic value of this examination method was not so high. It was necessary to find a more specific way to determine the tendency to suicide, and in this, scientists turned to genes.

Many researchers hypothesize that persistent GGBT activation in suicidal individuals is due to the insensitivity of receptors to glucocorticoids, similar to how insulin resistance of the body's tissues leads to type 2 diabetes. All efforts were directed to the study of the FKBP5 protein, which is included in the structure of the glucocorticoid receptor. It was found that the combination of one of the structures of FKBP5 with psychological trauma in childhood significantly increases the likelihood of suicide in the future. Unfortunately, this information has brought researchers little closer to a suicide biomarker. A biomarker needs to be simple, and in this case it has to take into account the person's past, even though the past may have been misrepresented by the person himself in the conversation with the doctor.

A specific protein SKA2 (spindle and Kinetochore associated complex subunit-2) is also associated with glucocorticoid receptors. This protein is responsible for modulating the activity of these receptors inside the cell, and its deficiency leads to a prolonged and excessive response of the brain to stress. To investigate whether a particular variant of SKA2 is associated with suicide, Johns Hopkins University scientists performed genotyping of brain tissue samples from deceased individuals and examined the DNA of participants in several mental health projects. A high level of methylation of the SKA2 protein gene and a decrease in its expression in the brain were found in suicidal individuals. Frozen, non-autolyzed corpse

samples were used in the work. In living study participants, low levels of SKA2 were found to be significantly associated with increased levels of cortisol and a shift from suicidal thoughts to active actions. The results of all groups showed that the SKA2 protein has a functional relationship with the SAT1 (spermidin/spermine N 1 – acetyltransferase 1) protein. The latter protein is involved in controlling the intracellular concentration of polyamines and their transport outside the cell. High levels of SAT1 in patients diagnosed with bipolar affective disorders are associated with past suicide attempts and future suicidal acts.

Summary. The analysis of scientific literature shows that in the modern period of the development of scientific knowledge in our republic, there is a tendency to study the connection of signs and sign systems describing various constitutional and personal aspects of individuality. One of the important tasks of modern scientific theory and practice is the interest in determining the characteristics of different systems of the organism, the study of the meaning of intersystem relationships in the structure of the individual at the constitutional, as well as psychological level.

In this regard, the search for markers that allow to identify individuals prone to suicide in order to carry out preventive measures in order to prevent suicide cases is becoming extremely urgent.

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