



Consequences Assessment of Destructive Informational Effects on the Basis of Complex Analysis of Biomarker System and its Overcoming

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Abstract

The article is based on the concept of forming various stress-related disorders in crisis situations. It is proved that destructive informational effects in modern conditions are an integral part in the formation of crisis situation syndromes and post-traumatic stress disorder. In the course of research, the possibility of using the system of biological markers for timely detection and effective treatment of stress-associated and informational disorders was established (before other clinical symptoms or their reaching diagnostic threshold). It also allows timely assessment of the subjective adaptation threshold of people at risk, to identify and reduce the negative effects of stress-related disorders. The use of the biomarkers was also researched for the diagnosis, treatment, rehabilitation, prevention of stress-related disorders among participants of crisis situations.

Keywords: Post-Traumatic Stress Disorder; Hybrid War Syndrome; Model; PTSD Hybrid War Syndrome; Information Cognitive Trauma; Set Of Measures; Instrumental Diagnosis pf PTSD

Introduction

Nowadays different crisis situations have become an integral part of life in number of countries. Man-made disasters, emergencies, wars and military conflicts, life-threatening experiences, bullying, neglect, ill-treatment or observation of such injuries by others, destructive information, cognitive and cyber effects on people, including the use of information and cyber weapons, result in the formation and development of various stressful conditions, including post-traumatic stress disorders. It can be provoked by the dominant information component, as shown by the research.

It is proved that the information component in modern conditions is integral part of the crisis situation syndrome and post-traumatic stress disorder. As their component it serves the development of mental disorders, including reactions of combat and military-occupational stress. It promotes the combination, multiorganism of pathological changes that occur in any lesions. Thus, one of the significant consequences of the COVID-19 pandemic was an increase in the information load on people. Disinformation related to the pandemic has led to the formation of pandemic information stress, deterioration of psychosomatic conditions and exacerbation of diseases. At the same time, the cognitive spheres of both individuals and society as a whole were under

threat. Information and cognitive influences lead to a change in the model of the world and its perception by a person, in social groups and in society as a whole, on emotional, moral, cultural, ideological and mental levels, with the formation of stereotypes for perception of reality through their prism. Particularly dangerous, however, is the imposition and promotion of erroneous views, which are most effectively promoted and implemented through the information and cyberspace. In addition, destructive information effects have their specific negative consequences. One of them is information and information-cognitive trauma and the development of specific post-traumatic stress disorders. The combination of these factors requires serious research.

The peculiarity of modern crisis situations are specific symptoms among most of their participants and among those, who find themselves in the crisis area. It is associated with the complex effect on physical, psychological, informational and other factors on them. The number of people diagnosed with such symptoms is growing and significantly exceeds the number of those who have other lesions. The symptoms themselves are constantly changing and becoming more complicated. Changing the nature and features of modern wars has a significant impact on the etiology of crisis syndromes [1,2]. First of all, this applies to the features, means and methods of modern warfare (military conflicts). In modern military conflicts, there is a steady trend of their participants using innovative forms, methods, techniques and technologies of action, both experimental and serial high-tech models of weapons and military equipment. They are usually more efficient than existing mass production models. Complex informational, psychological, cybernetic and cognitive purposeful and chaotic effects also take place [3-7].

All these features, factors and their interaction, a high level of nervous and emotional stress, the vital need for constant concentration, significant physical activity (especially directly during combat actions) in combination with a tense situation and unusual conditions determine the structure and course of the disease.

Crisis situations are not only wars and military (armed) conflicts, but also catastrophes, emergencies, and others. In turn, from one crisis situation to another, the syndromes of these crisis situations become more complicated, multifaceted, multisymptomatic and multisystematic. Such symptoms also occur in civilians who find themselves in a war zone. Moreover, similar syndromes occur among many people, who find themselves in a zone of any crisis. For example: areas of modern military (armed) conflicts, man-made or natural disasters, places where terrorist acts have occurred etc.

Therefore, the study of the causes, features of the crisis syndrome development in general and especially the formation of post-traumatic stress disorders (modern wars, military (armed) conflicts), as well as the development and justification of methods and innovative measures for diagnosis, treatment, rehabilitation and prevention of stress-associated and post-traumatic stress disorders among participants of crisis situations and overcoming crisis situations, is the most relevant and important in modern conditions.

Objectives

The aim of the research is to study the formation of stress-associated disorders in modern crisis situations, especially as a result of various information effects. The research focuses also on development of a comprehensive technology for timely detection, diagnosis, treatment, rehabilitation, prevention and evaluation of the stress-associated disorders treatment (PTSD and others), uncomplicated and complicated by other symptoms of crisis syndromes using objective hardware examination methods based on complex analysis of biomarker measurement results.

Analysis

A large number of researches have been devoted to the study of war syndromes and PTSD as an integral part of them. Thus, this issue has been actively studied at the Institute of Medicine and the National Academies of Sciences, Engineering, and Medicine; Sierra Tucson, National center for PTSD, The refuge (USA) as well as many authors (Horowitz, Davidson JR, Solomon Z., Proctor SP, Matthew Tull, Dursa EK, Snedkov EV, Vasilevsky VG, Fastovets G .A., Etc.). They show that in the course of each war, its participants developed specific conditions, named after the location, where it took place. The first studies on this subject were made after the Vietnam War. Then number of syndromes were investigated: Afghan War Syndrome, Iraq War Syndrome, Persian Gulf Syndrome, etc. Among the symptoms of war syndromes, almost all researchers recognize PTSD. Although the Vietnam War syndrome is associated by most researchers with PTSD, subsequent syndromes have changed and become more complicated, but in the etymology of all of them there is PTSD [8,9].

Until now, PTSD is mostly diagnosed by obtaining from the patient all the details of the story that happened to him, and then examining the history of each symptom. There are a number of diagnostic criteria, and if you observe enough symptoms, then you can diagnose PTSD. Many studies have been devoted to the difficulties in diagnosing PTSD. The complexity of PTSD and the complex set of rules, by which

we classify individuals according to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). One of the consequences of its expansion is that it increases the amorphousness of the classification. This is evidenced by the description of 636 120 different ways in which an individual can be diagnosed with PTSD [10,11]. Using the binomial equation to elucidate possible combinations of symptoms, the authors showed that the DSM-IV criteria listed for PTSD have a high level of symptom profile heterogeneity (79,794 combinations); the changes lead to an eightfold expansion in the DSM-5, to 636,120 combinations [12]. However, there are people whose disorders fail to meet the diagnostic criteria because they do not have all the symptoms, but still have symptoms associated with PTSD. The ability to identify those who may be at risk of developing PTSD after traumatic exposure through hardware has benefits with great potential for public health. Identifying people at risk of developing long-term emotional «scars» after contact with traumatic stress, and then using this information to prevent the onset of PTSD - is of great interest. This opportunity will not only improve the quality of life associated with health for people at high risk, but also reduce the financial burden on the health care system. Therefore, in the leading countries of the world there is an intensive search for biomarkers of PTSD. Biomarker is defined as a process, substance or structure that can be measured in the body or its products to analyze the risk of developing a disease, diagnose the disease, assess the progress and prognosis of the disease, predict the outcome of different treatment options before use or to determine treatment effectiveness [13].

Unfortunately, the search for biological markers for PTSD is currently still largely inconclusive [14]. Although there have been significant achievements in this area recently. Pupil responses to threat constitute a potential physiological marker of PTSD. A major strength of this measure rests in its objectivity, improving detection of who may be at risk for PTSD and enhancing diagnostic precision. Veterans reporting relatively higher levels of PTSD symptoms had larger pupils to all negatively valenced pictures and spent more time looking at them than did veterans lower in PTSD symptoms. Veterans higher in PTSD symptoms also showed a trend towards looking first at Iraq images. The findings suggest that posttraumatic pathology is associated with vigilance rather than avoidance when visually processing negatively valenced and trauma relevant stimuli enhanced emotional response to both negative and positive images in post-traumatic stress disorder [15]. However, they do not provide an answer to the question of how it is possible to objectively, on the basis of instrumental measurements and comprehensive analysis of the biomarker system, identify and assess the consequences of destructive information effects and take effective measures to overcome their negative consequences.

Methods and Stages of the Research

The following research methods were used: systematic approach analysis, bibliosemantic, historical, medical-statistical, sociological, expert assessments.

Achieving the goal of the study necessitated the use of a systematic approach to determine the order and content of research, which involved its implementation in several stages.

The first stage included the analysis of the theory and practice detection, treatment and prevention of post-traumatic stress disorders among people in crisis situations (wars, military (armed) conflicts, hostilities). The peculiarities of modern military conflicts and the evolution of factors effecting the development of post-traumatic stress disorders were studied. It provided an opportunity to obtain representative results to assess the condition of the researched people.

The second stage contained the definition of problematic issues of objective detection, comprehensive analysis, treatment and prevention of post-traumatic stress disorders, the choice of research field. It defined the subject and the object of research, formulated its purpose, objectives, and substantiated the scope and methods of research.

At the third stage, new and improved existing methods and models are synthesized. A set of measures for the organization of detection, treatment and prevention of post-traumatic stress disorders in crisis participants has been developed and substantiated. Based on the analysis and research of the current state and trends in the emergence and development of crisis syndromes, it is identified the general and specific features of the syndromes of specific crises at the place, where they occurred, the factors that influenced their formation and symptoms that characterize them.

The analysis and systematization of data were conducted on the complex impact of stress factors and other symptoms of crisis situations on people, who were in the zone of military conflict / man-made or natural disaster. New concepts, strategies and tactics of work in crisis situations were formulated.

A method for the differential diagnosis of crisis syndromes has been developed, which allows making a differentiated choice of tactics for the prevention, diagnosis and treatment of these conditions.

It is investigated that in the conditions of modern crisis situations information and cognitive effects are intensive, constant and mostly destructive. Therefore, it is

important to study the features of PTSD obtained as a result of mainly information and cognitive destructive effects. It differs from conditions of direct participation in combat actions. It is established that the formation of PTSD among specialists of specific categories and specialties, who do not participate directly in combat zones, but are in a state of increased psycho-emotional and psychophysical stress (with fluctuations in pressure in a wide range), has its own specific features.

A methodology for using PTSD biological markers to examine people in crisis situations has been developed in order to objectively identify the fact that they have PTSD. Reference markers for PTSD detection were obtained [4,5]. Based on the analysis and generalization of the obtained data on people, who were in a crisis situation, an innovative set of measures for detection, diagnosis, treatment and rehabilitation (with the support of objective instrumental research methods) of crisis syndrome has been developed.

At the fourth stage the complex system of prevention crisis syndromes is developed and practically implemented. Unlike the known ones, it involves "accompanying" a person at all stages (before, during, after) being in a crisis situation, using objective instrumental (hardware) research methods. This provides a subjective-personal increase of the adaptive threshold of a person to the effect of stressors, at all stages of official activity to direct participation in crisis situations. Raising this threshold significantly reduces the chances of developing PTSD and other stress-related disorders.

Methodology

Studies conducted by the authors have shown that the results of observation and analysis of changes that occur in the visual analyzer under the influence of various stressors can be effectively used to detect PTSD. The visual analyzer has many connections to the brain at different levels. The visual tract is connected to the lateral geniculate bodies and the hypothalamus by retinohypothalamic tracts. Fibers from the lateral geniculate bodies go to the visual cortex, amygdala, upper dichotomy and spindle-shaped gyrus. Fibers from the suprachiasmatic nuclei of the hypothalamus are associated with the pineal gland and amygdala. The visual cortex is associated with the amygdala, the upper humerus, and the fusiform gyrus. The upper humerus is associated with the amygdala, spindle, and hypothalamus. The spindle-shaped gyrus is associated with the amygdala and the upper humerus. There are a number of predictable connections in human body that are found in other species: the visual cortex is the hypothalamus, the hypothalamus is a spindle-shaped gyrus, the amygdala is the upper humerus, and the pineal gland is the amygdala. Parasympathetic innervation includes the following connections: upper humerus - Edinger-Vetfal

nucleus - ciliary ganglion - short ciliary nerves. Sympathetic: hypothalamus - ciliary spine - upper cervical ganglion - short and long ciliary nerves.

The study of eye movements is an informative tool for understanding the degree of central control of motor functions, both in normal and in pathology caused by stress. To study the functions of the central nervous system, 3 types of saccades are used:

- Directed saccade (on a simulated stimulus in the environment);
- Anti-saccade - suppression of the reflex saccade in the form of a conscious redirection of the gaze in the direction opposite to the stimulus;
- Saccada, produced «by memory» - alternating movements between two stimuli performed in a specified period of time.

The following PTSD markers were researched: pupillary reactions and changes in accommodation, eye movements, including saccades, vergent and allied movements change as a reaction to environmental and internal human conditions, which is observed in various diseases and psychosomatic human conditions. The relationship between stress-related disorders and changes in pupil size, eye movement parameters, visometry, near-convergence visibility, the nature of binocular vision, fusion ability (ophthalmic biomarkers) was experimentally established. Studies of eye movements can also determine cognitive functions. The question of whether this reflex can serve as a diagnostic marker of PTSD was considered. It has been studied that people with PTSD show significantly more pupil dilation for threatening images. This effect was observed regardless of the time elapsed since the injury, the cumulative effects of violence and anxiety.

The following biological markers for the diagnosis of PTSD were identified: deregulation in the hypothalamic-pituitary-adrenal system, the presence of hyper reactivity of the sympathetic adrenomedullary system, increased reflexes of the quadriceps, cognitive impairment, "anatomical" markers, such as reduction of amygdala, prefrontal cortex, hippocampus. However, it has been proved that the most reliable biomarker is the quadriceps reflex.

The amygdala is responsible for primitive emotions, when activated, there is dilation of the pupils. Among people, who have been abused, there is a constant hyper-excitation of the amygdala, which signals a constant search for signs of danger. Eye movements look sharper, characterized by an increase in the number of saccades. Pupil dilation is a sign of fear and indicates the activation of peripheral vision and exacerbation of motion detection. The above symptoms are characteristic of the activation of the magnocellular visual pathway. Despite the fact that this path is only 10% of the

fibers of the visual tract, the pulse passes very quickly, which allows you to quickly respond to external threats. Pupil narrowing allows to concentrate on the central vision, increases the saturation, informativeness of the image by the cost of losing part of the view. People, who have been abused, show signs of severe PTSD. Their eyes look “glassy”, the pupils are wide, the movements are minimal, and their gaze is not concentrated on anything and is so to say “empty”. They may not turn to the interlocutor during the conversation. There may be no reflexive gaze towards a sharp sound or spontaneous movement. Other signs of violence are tunnel narrowing of the visual field, impaired three-dimensional vision, impaired color perception, decreased overall visual activity.

The close connection between the development of PTSD in crisis syndrome and the informational and cognitive effect suggests the possibility of using neurobiology and physiology in the objective diagnosis of PTSD. It is well-known fact that the eye is a part of the brain brought to the periphery. For example, the amygdala is responsible for primitive emotions, and when it is activated, there is dilation of the pupils. The research has proved the presence of specific oculomotor changes specific for people, who have experienced acute stress.

Certain groups with PTSD, which was formed despite they were not in crisis situations, are people, who are responsible for taking decisions and/or use high-tech tools to solve responsible tasks. Every year due to technological progress there are more and more new technologies and devices. Computer technology is firmly entrenched in various spheres of human life. Every work requires a wide range of visual tasks. Many professions are associated with a strong, and most importantly an unusual stress provoked by physiological functions, where working conditions can be described as extreme (production of electronic equipment, microdevices, computer equipment and work with them). Getting used to working conditions is a separate type of complex biological phenomenon - adaptation. The process of adaptation and its physiological essence is in maintaining the functional state of homeostatic systems and the body as a whole, which ensures its preservation, development, efficiency, maximum life expectancy in inadequate environmental conditions.

Therefore, a comprehensive research of the system of biomarkers was conducted among people in crisis situations, in particular among military personnel participating in combat zones and people living in combat area. At the same time, the features of eye movements, pupil condition, accommodation and convergence as possible markers of PTSD among people, who were in crisis areas, were identified. This specific group of people was compared with

healthy people living in another area.

Technology of Detection, Diagnosis, Treatment, Rehabilitation and Prevention of Crisis Situations Syndromes and Stress-Related Disorders based on Biomarkers

The authors have developed and researched the technology of detection and complex analysis, crisis syndrome and PTSD as an integral part of the method of its instrumental and hardware diagnostics based on the measurement and analysis of biomarkers.

The technology includes:

1. Establishment of possible etiological factors influencing the formation of crisis syndromes.

Differentiation of factors by:

- Time period of impact: acute and chronic stress exposure shock stress / accumulated stress;
 - Physical / mental / informational effect component (conventional / unconventional effect);
 - Presence of preliminary factors before the crisis. Presence / absence of education and specialty, previous social phobias;
 - Degree of responsibility and tension in a crisis situation;
 - Work with innovative tools and devices.
2. Detection. On the basis of the mechanisms, involved in the development of the syndrome (mental, physiological and neurophysiological), the creation of methods of comprehensive assessment and diagnostic algorithms (the use of hardware objective methods for research of human sensory systems).
 3. Differential approach to treatment, which is based on the choice of different methods of therapy, depending on the established various etiological factors.

In order to identify possible risks of developing syndromes of crisis situations and stress-related disorders, two types of researches are conducted:

1. Comprehensive examination. Conducting psychological testing/interview in parallel with the registration of eyeball movement and pupillary reactions. The combination of such examinations is due to the fact that the basic instincts of survival are responsible for the amygdala-limbic system, one of the obvious symptoms of which is the vestibulo-ocular reflex or the quadriceps reflex. For more complete information it is possible to combine with the registration of heart rate and respiratory rate.
2. Software and hardware research of the biomarker system. Researches on accommodation, convergence, dark adaptation, fields of vision, circulatory system of the eyeballs and electroretinography (ERM) before and after the use of electronic visual display of information for a certain period of time.

On the basis of the received data there were developed individual recommendations on use time and multiplicity of special electronic display of the information during the day, performance of a complex of exercises and pharmacological correction.

If during the examination changes in certain biomarkers of the syndrome were detected, there is a necessity to refer to a specialized institution for further additional examination and therapy.

Methodology of Hardware-Instrumental Detection and Diagnosis of Stress-Associated and Post-Traumatic Stress Disorders by Biomarkers

- **Methodology Description:** The first stage of solving the task was to develop a method of studying people with PTSD, while fixing objective indicators (heart rate, blood pressure, eye movement) - biomarkers, and a specific test audio stimulus, the study of some functions of the visual organ with minimal subjective component.

A number of practical experimental studies were conducted and the composition of tools and methods for the hardware and instrumental detection and diagnosis of stress-associated and post-traumatic stress disorders.

The people were divided into control and main (study) groups. They were explained the goals and objectives of the study, obtained prior consent to participate in the research, assigned a place and time of the meeting. The research protocol was agreed and approved by the local control commission and complied with the Declaration of Helsinki.

According to psychological testing among all respondents, who were in the main group, were found significant symptoms of PTSD, which were not detected in the control group (healthy individuals).

Surveys and studies of the main and control groups were carried out according to the same scheme and methodology.

- **Research:** The respondents sat in a chair, in front of them there was a table with a personal computer monitor at a distance of 50 cm from the eyes of the respondents. Under it on a stand there was a device "Eye-Tracker". To the right of the respondent at the table sat a specialist working on "Eye-Tracker" with a laptop, through which he controlled the operation of the device. To the left of the respondent at the table there was polygraph examiner with a laptop and a polygraph, taking measurements.

The verbally stimulating material was a test for the diagnosis of PTSD, which is included in the appendix to the order of the Ministry of Health of Ukraine №121 from 23.02.2016 "Unified clinical protocol of primary, secondary (specialized) and tertiary (highly specialized) medical care". Stress response and adaptation to disorders, post-traumatic stress disorder are recommended for physicians of all specialties for PTSD screening.

At the same time, we evaluated the characteristic features of eye movements, which were registered with the help of an Eye-Tracker and compared them with polygraph data of patients with or without PTSD. The following indicators were selected from the Eye-Tracker session of each respondent: question and response time, maximum fixation time in one place, number of individual visual fixation sites, number of sectors involved (from 1 to 9), most and least affected sectors, loss of concentration.

The research protocol was approved by the local supervisory board and is in line with the Helsinki Declaration. Written confirmation agreement was obtained from all respondents.

Establishment of Reference Indicators of PTSD Ophthalmic Biological Markers According to the Developed Methodology of Hardware-Instrumental Detection, Diagnosis of Stress-Associated and Post-Traumatic Stress Disorders

The studied indicators of visual functions (convergence, accommodation, near visual acuity) were worse among patients with PTSD. Pupils were wider, and the time of onset of the stereo effect was longer among patients with PTSD.

Thresholds of stereo vision corresponded to the norm in the group without PTSD - and amounted to 200 angles in 90%, while in the group with PTSD such a threshold was 33.1% ($\chi^2 = 4.08$, $p = 0.04$), and according to the Stereo-fly test - normal thresholds were established in 63.3% of healthy people and only in 20% of PTSD ($\chi^2 = 4.9$, $p = 0.02$).

When evaluating the preliminary data obtained on the Eye-Tracker among majority of patients with PTSD (80%) vision fixation was in the central or upper-central sector of the visual field. In the healthy group, fixation of the gaze was observed in the central, lower-central and 40% in the upper-central sector. The change of the sector at sight changed from 1 to 6 times in 70% of cases, however in both groups there were patients (20%) among whom the frequency of change of fixation was observed 11-14 times. The maximum fixation time at one point was on average longer - ($3.02s \pm$

1.75) s among patients with PTSD compared with the control group - (2.22 ± 1.5) s, ($p = 0.04$). Automatically measured pupil diameters in both groups confirm the data obtained manually, with the same lighting mode (10 lux). Patients with PTSD have larger pupils.

Thus, the data obtained led to the conclusion that the tests can be converted into objective criteria for assessing and examining the state of PTSD, as well as screening programs.

Results

In total, almost 40,000 people involved in crisis situations were examined, treated and provided with psychological support using the developed technology. Among them 6715 people, who were diagnosed under the heading of neuroses diseases revision F43 «Neurotic, Stress-related and Somatoform Disorders». According to our observations PTSD symptoms were detected among 1881 patients (28%).

The fully developed technology with the use of objective hardware examination methods was implemented when working with 1495 (79.47%) patients.

Of particular interest in the research were 1547 (23.03%) among all treated patients in the clinic under the heading F43 «Neurotic, Stress-Related and Somatoform Disorders» with positive ophthalmic biomarkers. According to F43 they did not have sufficient clinical criteria to diagnose PTSD. Patients in this group reported minor complaints of mental health in the form of: excessive fatigue, irritability, shallow sleep, decreased ability to work, unstable mood. According to psychological testing, they showed mild neurotic symptoms mainly of situational origin. The existing changes in the mental status of patients were considered insignificant. Common characteristic of this group was that these people were in the combat zone for 6 months or more. Their professional activities were associated with negative informational effects on them.

Taking into account the connection between the visual analyzer and the psychological state of patient, there is a need to implement a differentiated approach to the treatment of PTSD, paying special attention to patients at risk with positive bioophthalmological markers as reliable symptoms of pre-PTSD at the preclinical level.

The treatment was started in accordance with the «Unified Clinical Protocol of Primary, Secondary (Specialized) and Tertiary (Highly Specialized) Medical Care Response to Severe Stress and Adaptation Disorders, Post-Traumatic Stress Disorder» approved by the Order of the Ministry of Health of Ukraine 02/23/2016 №121.

In the first group with the relatively satisfactory condition of patients and their refusal of drug therapy, treatment began in the form of sessions of psychotherapy and psycho correction. At the same time, the biomarkers were re-determined after 3 weeks and the final one was performed immediately before the patient was presented for examination.

After analyzing the obtained data of measured PTSD biomarkers, the first group (1439 people) was additionally divided into three subgroups.

The first subgroup included 891 patients (62%), among whom PTSD biomarkers completely disappeared after three weeks of psychotherapy; patients noted a significant improvement in mental status.

The second subgroup included 362 patients (23%), who after three weeks of psychotherapy did not show a decrease in the number of critical changes in PTSD biomarkers. In this subgroup, symptomatic drug therapy with a short course was additionally prescribed. After treatment, patients came again for examination and consultation, during which, as a part of the research, PTSD biomarkers were re-determined. As a result, it was found that PTSD biomarkers returned to normal.

In the third subgroup of 186 patients (15%) on the third week of psychotherapy PTSD biomarkers did not return to normal. Instead, clinical PTSD symptoms were identified. These patients were prescribed drug therapy, which continued in rehabilitation centers. After medical and psychological rehabilitation, patients were re-referred for a final examination to the clinic.

Summarizing the above data and taking into account the significant socio-economic effect, already visible from the locally implemented set of measures for detection, comprehensive analysis, treatment, rehabilitation and prevention of PTSD using objective hardware methods of examination appears theoretically, practically, socio-economically feasible implementation of this technologies and a differentiated approach to the treatment of people with (F43) «Neurotic, stress-related and somatoform disorders» at the national level.

Results of the Research

Development and systematization of the theory and practice of research on syndromes of crisis situations which allows generalizing various syndromes and at the same time to reveal a difference between them. On the basis of the analysis and research of a modern condition and tendencies

of emergence and development of syndromes of crisis situations their general and specific features are revealed. They are inherent for the syndromes of specific crisis situations at the place where they occurred, the factors that effected their formation and the symptoms that characterize them. Crisis syndrome (wars, military conflicts, man-made, natural disasters, terrorist acts, etc.) are conditions that are in the form of a complex of characteristic mental, psychosomatic and physiological changes. Changes occur among a large number of people, who were at a certain time in a certain place, involved in the same events, processes, actions, and who have undergone a set of traumatic effects of different nature and complex informational and mental effect. The analysis and systematization of data on the complex effect of stress factors and other signs, symptoms of crisis situations among people, who were in the zone of military conflict / man-made or natural disaster.

The authors for the first time developed a method of differential diagnosis of crisis syndromes, which provides effective diagnosis and treatment of these conditions.

Crisis syndromes, including "hybrid war syndrome", have been studied and described. Common and different at the same time with the Persian Gulf syndrome, which is not only a psychosomatic disease, but it also affects almost all body systems: central nervous system, gastrointestinal tract, heart, liver, immune system, endocrine system, bones and skin. At the physical and physiological levels of the hybrid war syndrome, in addition to the development of PTSD, the development of a number of disorders of the visual analyzer (more than 90% of patients), and as well as somatic disorders take place. Somatic symptoms of the hybrid war syndrome developed in 75% of cases. They were manifested by: headaches, dizziness, physical weakness, pain and discomfort in various parts of the body, nausea, dysfunction of internal organs. Sexual dysfunction combined with interpersonal problems as family breakdown can be one of the symptoms; addictive disorders - alcoholism, drug addiction, gambling, return to extreme activities; clinical symptoms - personal and reactive anxiety, decreased emotional stability; socio-psychological - reduction of self-esteem, level of social adaptability and frustration tolerance; physiological - the predominance of the tone of the sympathetic nervous system over the parasympathetic, changes in hemodynamics; endocrine - increased activity of the sympathetic-adrenal and hypothalamic-pituitary-adrenal system; metabolic - increase in blood transport forms of lipids with a shift of the lipoprotein spectrum towards atherogenic fractions. In addition, the following massive somatoform disorders were observed among patients with predominant localization of bodily sensations, which are combined with psycho-vegetative paroxysms in cardiac (54%), gastroenterological

(26%) and cerebral (20%) anatomical areas. In the case of the hybrid war syndrome, for the first time, in contrast to the known syndromes, a ophthalmological pathology was detected and a system of its treatment was developed. The key factor in the development of the hybrid war syndrome is the consequences of informational and cognitive effects. It includes trauma, which is supported by the load on the human sensory systems (especially on the visual analyzer), as a striking factor. At the same time, PTSD is complicated by the effect of functional changes in the human sensory system. Thus, the syndrome of hybrid war is a condition in the form of a complex of mental, psychosomatic, physiological and cognitive changes. They occur to varying degrees among a population in the countries, involved in hybrid conflict, which have undergone a set of traumatic effects of different nature and a complex of informational, mental and cognitive effects. The syndrome has individual and group symptoms.

For the first time the model and mechanisms of PTSD formation in the conditions of hybrid warfare were developed and described, including specialists of specific categories and specialties, their basic similarities and differences between them were investigated.

The formation of PTSD among specialists of specific categories and specialties, who do not take a direct part in combat zone, but are in a state of increased psycho-emotional and psychophysical stress (with fluctuations in stress in a wide range) have their own specific features. These primarily include servicemen of government agencies, who prepare, make and implement responsible decisions, servicemen who use complex high-tech tools, and so on. Such specialists are under the effect of responsibility for the effectiveness of the use in the war zone or in enemy territory of high-value, high-tech means on which depends the effectiveness of troops (forces, units) in general and the lives of combatants (e.g. tank crews and especially UAV operators, etc.). The performance of their combat tasks is almost constantly under stress of variable intensity with a critical dynamic range of these changes relative to the limit of adaptation / maladaptation. A special category is military pilots, who perform tasks over enemy territory and in areas affected by enemy air defenses and those servicemen, who perform tasks in enemy-controlled territory.

A methodology for using biological markers of PTSD to examine people in crisis situations has been developed in order to objectively detect the fact that they have PTSD, and reference markers have been obtained for its detection. To detect this, changes in the oculomotor system and visual analyzer were studied. It has been established that among patients with PTSD there is a decrease in visual functions: decrease in visual acuity at close range, decrease in the

volume of accommodation and convergence, increase in pupil diameter, decrease in stereo threshold value. Using devices that provide high-precision tracking of eye movement (type Eye-Tracker) revealed: characteristic changes in the trajectories, increasing the time of maximum duration of fixation at one point and the tendency to fix the gaze in the central and upper central sectors. It was found that among patients with PTSD the following ophthalmic PTSD markers are most often observed (more than 90% of patients): dilation of the pupils, removal of the nearest point of convergence and the point of clear vision, decreased visual acuity at close range; for markers, increased fixation point time.

Based on the analysis and generalization of the obtained data on people, who were in a crisis situation, an innovative technology was developed for detection, diagnosis, treatment and rehabilitation (with the support of objective instrumental research methods) of stress-related disorders (PTSD, etc.) and other symptoms of crisis syndrome situations. The technology includes the identification of possible etiological factors influencing the formation of crisis syndromes with differentiation of effecting factors, followed by the formation of a differentiated approach to treatment. The difference from existing technologies is a comprehensive approach, using instrumental (hardware) methods and tools, which make the process of detection and diagnosis much more objective, and treatment and rehabilitation much more effective. It is based on the relevant changes in the eye and musculoskeletal system observed among patients in crisis. The developed technology allows to detect the presence and diagnosis of PTSD in doubtful cases (patients with PTSD, but without its clinical symptoms). This significantly increases the level of objective early detection and diagnosis.

There is also a step-by-step control of the effectiveness of treatment, assessing the dynamics of changes in objective PTSD markers (including ophthalmic diseases effect on them), based on further decision on prolongation of therapy, correction of medical and non-medical treatments, suitability for further military service. This technology also allows to identify the level of resilience of people to the possibility of PTSD formation and development in the dynamics at different stages of training. It is an issue of high concern for highly qualified servicemen, who work with complex high-tech models of weapons and military equipment, electronic means of displaying information. They have a high degree of responsibility for the tasks and are exposed to long-term intense psycho-emotional stress. These categories often tend to hide their symptoms, which complicates the detection, course and treatment of the disease. As a result it leads to the loss of valuable professionals, whose training involved high financial costs, efforts and time.

Discussion

Implications for Practice

Concerning clinical and biological PTSD complexity, the possibility of identifying a single biomarker is negligible. Prognostically, multiple biomarkers will be used as attributes of PTSD, risk assessment factors or objective symptoms of recovery [16]. It is known that there are anatomical connections between the cortex, oculomotor apparatus and brain structures responsible for the psycho-emotional state [17]. The study of eye movements is a good tool for understanding the control of motor functions, both in physiological and pathological conditions.

There is little research on eye tracking among war veterans. Most of them rely on visual stimuli, while we used them in conjunction with verbal stimuli. One study linked PTSD to vigilance as opposed to avoidance. Veterans with relatively higher levels of PTSD symptoms have a more pronounced degree of mydriasis on the negative image. They tended to maintain a longer fixation time and preferred images with military content. These data also mean that post-traumatic stress is associated with vigilance, not avoidance. The authors identified the presence of mydriasis among patients with PTSD [18]. In another study, which examined the model of vigilance avoidance, the authors found that attention is drawn to a possible threat, accompanied by a specific autonomic arousal [19]. These articles focus on the study of the vigilance avoidance mechanism and are of great interest to the psychological sciences. The research focused on identifying possible biomarkers. The main functions of the visual analyzer (saccades, pupillary reactions, degree of accommodation and convergence, stereoscopic threshold, visual acuity) were studied. In addition, the variety of stimuli (visual or verbal) was a key issue in the work. The results are relevant to researches, mentioned above: in addition to measuring mydriasis, a longer fixation time was found among patients with PTSD, which may also prove the connection of PTSD with vigilance.

Research has shown that hybrid war syndrome (hybrid conflict) is a condition that is characterized by mental, psychosomatic, physiological, and cognitive changes, which occur to varying degrees among populations of countries involved in hybrid conflict; a combination of traumatic effects of different nature and a complex of informational, psychological and cognitive effects that have individual and group symptoms.

Studies have shown that in addition to the PTSD development, a number of disorders of the visual analyzer and oculomotor system are also evidence of hybrid war

syndrome. The set of specific data that we received provides great prospects in terms of PTSD diagnosis, as several biomarkers have been identified.

Conclusion

A retrospective analysis showed that PTSD (or associated symptoms) and other similar specific symptoms, as an integral part of war syndromes, occur among people in crisis, especially among veterans of almost all wars and armed conflicts of the second half of the 20th and early 21st century. Moreover, it differs significantly from participants in various military conflicts. And the information component is essential in the formation of these syndromes. A comprehensive medical and social study assessed the consequences of destructive information effects, identified the need for the health care system for people at risk group of integrated system, as a whole structurally and functionally interrelated measures for the detection, analysis, treatment, rehabilitation and prevention of stress-associated disorders, especially due to these effects. This necessitated the development and scientific substantiation of methods and a set of measures to overcome them.

It is determined that despite numerous studies, no tools, methods, techniques and technologies have been developed to detect, recognize and classify the results and symptoms of the full range of effects, especially destructive informational effects, which significantly contribute to the formation of "crisis syndrome", stress-associated disorders and post-traumatic stress disorder (PTSD).

Early diagnosis can reduce the risk of PTSD and it is necessary to provide diagnostic support to the patient in order to timely treatment and correction of psychosomatic and somatopsychic conditions. Thus, the conducted work has shown that solving the problem of early diagnosis of stress-related disorders (including those in combat actions) requires further support and the availability of appropriate hardware and software that will provide the possibility of instrumental, objective diagnosis of biomarkers.

Approbation and experimental research of the developed technologies, methods and schemes of treatment and prevention proves their efficiency in comparison with well-known methods. The use of technology of objective instrumental detection and diagnosis of people with PTSD and their treatment with instrumental control of its effectiveness (efficiency and quality), allows, due to accurate algorithm and objectification, to reduce treatment time, reduce the resources of forces and means directed at achievement the ultimate goal.

This is facilitated by early detection and timely treatment at the pre-PTSD stage, when the picture of the disease has not reached maximum clinical development. This allows you to minimize the cost of treatment, by, in most cases, reducing the amount of therapy only to psycho-correction. This makes it possible to reduce the cost of public funding for pharmacotherapy and inpatient treatment. The proposed and put into practice technology allows to prevent severe cases of PTSD with the development of possible complications (gambling, suicide, delinquent and addictive behavior), which require expensive and long-term treatment. In the future, timely treatment provides prevention of chronicity of the process and prevents disability, which requires specific social and legal protection and appropriate funding. In general, the proposed technology will increase the social "health of the country" by reducing crime, employment problems, reducing intra-family conflicts and more.

The main result is the development and research of methods and technologies for assessing the consequences of destructive information effects based on a comprehensive analysis of the PTSD biomarkers system and other stress-related disorders and measures to overcome them.

Further research is focused on the selection and justification of PTSD predictors based on the analysis of biomarkers, as well as the development, based on previously obtained data on the reactions of people during test on selected stimuli, machine learning and artificial intelligence, method and system of instrumental assessment of psycho-emotional status and resistance of people to stress loads of different nature, testing people on functional propensity to effectively perform certain tasks and on professional burnout.

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