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ENDOTOXICOSIS AFTER PSYCHOLOGICAL CORRECTION

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Abstract

The article is devoted to the study of the phenomenon of endogenous intoxication and the theoretical substantiation of its development after psychological correction. Psychological stress leads to the induction of psychological trauma. Psychotrauma has a long-term negative impact on the psychological and somatic state of a person and contributes to the development of psychosomatic diseases. Conducting psychological correction using personality-oriented, humanistic, behavioral, suggestive psycho technologies allows one to get a positive effect and alleviate suffering, and sometimes completely positively resolve the issue. The article analyzes the development of endogenous intoxication after psychological correction of stress-induced psychotrauma with intense emotional experience of a traumatic situation. The results show that in all cases there was an increase in the concentration of middle toxic molecules in blood samples. This led to the development of psychological and somatic symptoms of endotoxicosis in more than 80.0% of cases. It is likely that psychological stress and psychological trauma lead to the formation of intermediate toxic metabolites, which are partially deposited in tissues. During an intense emotional reaction related to psychological correction, peripheral receptors are activated and endogenous toxins flow from their depots into the blood. This can lead to the development of endotoxicosis after psychological correction. It is rational to continue research in this direction.

Keywords: Psychological stress, psychotrauma, emotions, psychosomatics, psychological correction, endogenous intoxication

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1. Introduction

Currently, information overload, an increase in emotional stress and social immobilization in combination with the introduction of restrictive quarantine and self-isolation regimes due to the COVID-19 pandemic lead to depletion of the central nervous system (CNS). Psychological stress (PS) leads to the accumulation of individual psychotraumatic experience and negatively affects the functional state of a person at the organismic level. That is, PS induces psychotrauma, leading to psychological (Siegel et al., 2018; Uddin et al., 2018) and somatic (Meuret & Tunnell, 2020; Wong et al., 2019) diseases. The response to PS depends on the state of the hypothalamic-pituitary system, the aggregate of excitation in the limbic system, the reticular formation and the amygdala (Barrett et al., 2019; Hoemann et al., 2020) and the correspondence of CNS resources to it (Brosschot et al., 2016).

Experiencing a traumatic experience with an intense emotional reaction after psychological correction can lead to disturbances in the psychological and somatic state. These disorders can persist for up to 10-14 days, and their duration and intensity is determined by the individual reaction to psychological trauma (Salekhov et sl., 2019a; Slavinsky, 2005). The mechanism for the development of such a reaction after psychological correction has not been studied.

2. Problem Statement

Modern lifestyle is characterized by a decrease in the number of life-threatening situations and the emergence of stressors perceived as life-threatening (Brosschot et al., 2018). The biological stress (Selye, 1936) was replaced by the PS (Lazarus & Launier, 1978; Shcherbatykh, 2012), addressed to the central nervous system.

At the same time, the response to PS and behavioral features are determined by the individual perception of the current situation, the state of the central nervous system and the somatic state of the body (Chrousos & Gold, 1992; Mindubaeva et al., 2019).

Psychological trauma induced by emotionally-charged stressful situations or repetitive situations in which the intensity of PS exceeds the physiological and psychological adaptive capabilities of the body lead to distress (Brosschot et al., 2016). It is characterized by psychological disorders and somatic pathology (arterial hypertension, type 2 diabetes mellitus, asthma, etc.), which are activated after repeated exposure to psychological stressors (Chlebowy et al., 2019).

Particularly noteworthy is the unaddressed anxiety that occurs long before the expected stressful situation. PS and anxiety are interrelated and interdependent. The impact of a stressor as a trigger initiates an integrative response with physiological changes that affect the state of the central nervous system and the body as a whole. In this case, the state of the central nervous system determines the cognitive assessment of the situation against the background of emotional arousal and its implementation in the form of behavioral reactions. (Bystritsky & Kronemyer, 2014)

Anxiety depletes a person's resources and acts as trigger for intense emotional stress, impairment of cognitive function and development of somatic symptoms, which are markers of chronic physical

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illness, while emotional and cognitive dysfunctions indicate that there is a mental pathology (Meuret et al., 2020).

From an integrative standpoint, the response to stress is determined by the dominant excitation in the subcortical zone, which arises unconsciously in the format of uncertainty. As long as the situation is perceived as a controlled, non-hazardous response, stress is controlled by inhibition in the prefrontal area and high heart rate variability.

In contrast, when the situation is perceived as aggressive with an unpredictable outcome, even in the absence of a real threat, the standard stress response is out of control of inhibition in the prefrontal area. In this case, arousal in the limbic system, reticular formation and amygdala becomes dominant, and the stress response ensures survival in the form of a fight-or-flight response. The fight-and-flight response to stress is instinctive, reflecting a genetically determined focus on survival in extreme conditions (Brosschot et al., 2016).

The pathophysiological realization of anxiety disorder is induced by PS and is based on the discrepancy between the level of real or imagined threats and the effectiveness of coping strategies. This creates the prerequisites for the development of chronic anxiety disorders and their negative consequences (Strian, 1995).

An intense emotional response to PS leads to the release of catecholamines, adrenergic hormones, activation of the sympathoadrenal system, an increase in cortisol and glucose levels, a decrease in insulin levels, decreased sensitivity to it, and the development of insulin resistance (Wong et al., 2019).

The psychophysiological manifestations of post-traumatic stress disorder are dysfunction of the central nervous system and autonomic nervous system (ANS), suppression of the parasympathetic and activation of the sympathetic nervous system. This is manifested by tachycardia and superficial increased respiration, resulting in a low level of carbon dioxide (hypocapnia) in the exhaled air (Blechert et al., 2007).

Moreover, hypocapniacaused by anxiety disorders is a contraindication for cognitive-behavioral psychocorrection (Tolin et al., 2017).

It is noteworthy that in 75.1% of patients with peripheral arterial pathology, symptoms of depression, anxiety and stress were revealed, which were more pronounced during the initial visit. At the same time, the role of PS and mental disorders, their negative impact on the results of treatment of peripheral arterial diseases have not been assessed (Thomas et al., 2020).

PS leads to the activation of the sympathoadrenal system and the release of catecholamines. This leads to the development of peripheral angiospasm, impaired peripheral circulation and hypoxia. Therefore, the question of the significant role of psychological disorders associated with chronic PS in the development of peripheral arterial pathology should be considered.

Social factors are of great importance. They largely determine the response to PS, in particular social immobilization (Salekhov et al., 2019b). The peculiarity of the influence of the social factor is that moral and ethical norms and rules, in combination with social support, play the role of a shock absorber that reduces the intensity of stress and ensures a decrease in physiological reactions to its impact. However, this can lead to the accumulation of unresponded physiological reactions and social influences. Collectively, this can have a negative impact on human health (Birmingham & Holt-Lunstad, 2018).

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Thus, it was found that during the Trier social test, the activation of the hypothalamus-pituitary-adrenal axis and the sympathetic-adrenal-cerebral system increases. It has negative effects on the immune system, cardiovascular activity, stomach function, and cognitive function (Allen et al., 2013).

For the psychological correction of anxiety and stress disorders associated with trauma, humanistic, cognitive-behavioral, personality-oriented, suggestive approaches, or a combination of them are used, which allows one to get a positive effect, partially, and sometimes completely solve the problem (Gerger et al., 2020; Lopresti et al., 2020).

However, after psychological correction, with the experience of a traumatic experience and an intense emotional reaction to it, symptoms of deterioration of the psychological and somatic state may appear. They can persist for up to 10-14 days, and their duration and intensity are determined by the individual reaction to psychological trauma (Salekhov & Maksimyuk, 2019c; Slavinsky, 2005). At the same time, the mechanism for the development of such a reaction after psychological correction has not been studied.

Similar phenomena reflecting the somatic and psychological state of the body are observed in various diseases, after childbirth, stress and are manifestations of endogenous intoxication (Kosareva et al., 2019; Meltzer-Brody et al., 2017; Sakiev et al., 2017), and their intensity gradually decreases as the pathological process regresses.

Similarly, against the background of the normalization of the general psychological and physiological state, the positive effect of the psychological correction is noted.

3. Research Questions

Taking into account the information presented above, the main directions of research were formulated:

- How to identify the possibility of developing endogenous intoxication?
- How are toxins generated during stress?
- How to theoretically substantiate the features of the development of endogenous intoxication after psychological correction based on the results of our own research and data from scientific publications?

4. Purpose of the Study

The purpose of the study is to substantiate the significance of the development of endogenous intoxication after psychological intervention and the expediency of its prevention and correction.

5. Research Methods

The study was carried out in 2 stages:

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- Stage I–identification of the fact of the development of endotoxicosis after psychological correction;
- Stage II –theoretical substantiation of the formation of endotoxins in PS and psychotrauma; development of endotoxicosis after psychological correction.

5.1. Methodology for detecting the development of endotoxicosis after psychological correction

When performing the first stage of research to measure the level of endogenous toxins in the bloodstream after psychological correction, we first studied the dynamics of their content during the day, and then the peculiarities of their change after psychological correction. The criterion for assessing endogenous intoxication is the content of middle molecules (MM) in blood. MM are intermediate products of catabolism of protein macromolecules, which are formed, as a rule, under conditions of oxygen deficiency. MM have toxic properties, and an increase in their content in the blood suggests the development of endotoxicosis. The spectrophotometric method is used to measure the level of MM (Gabrielyan & Lipatova, 1984, Sulimanov et al., 2020).

The study involved 48 women who underwent psychological correction due to a deterioration of the psychological state caused by prolonged anxiety and psychotrauma. They all signed an informed consent to participate in the research program and a bilateral confidentiality agreement.

The average age was 34.2 ± 3.1 years. Studies were conducted in the absence of menstruation and pregnancy. The women did not participate in the ART program (assisted reproductive technologies).

Before psychological correction, under normal conditions, for 3 days in the morning before meals and water (8.00-9.00) and in the evening (18.00), the MM level in the blood was measured,

Taking into account the wide variability of the indicators of MM in the blood, an individual standard was introduced for each participant. The individual standard for this stage of the research was the indicators recorded in the morning of the first day, which were taken as 100%. The dynamics of MM indicators within 3 days prior to psychological correction was expressed as a percentage in relation to the indicators recorded in the morning of 1 day (100%).

In the evening on day 3, after taking blood to measure the level of MM, psychological correction was performed. When assessing the indicators of MM after psychological correction, the results before it, obtained in the evening on the 3rd day, were regarded as an individual standard (100%). After psychological correction, the measuring of MM in the blood was carried out 3 hours after its completion, and 12 hours later (in the morning of the next day (8.30-9.00).

Additional criteria were psychological and clinical symptoms of endotoxicosis that appeared 12 hours after psychological correction.

Psychological correction included an integrative approach combined with provocative, cognitive-behavioral, suggestive approaches and psychophysiological methods for regulating the emotional state. The duration of the psychological intervention did not exceed 75 minutes. In all cases, there was an intense emotional reaction to the traumatic situation induced by PS.

Statistical processing of the obtained results was carried out by the methods of variation statistics with the determination of the reliability of the differences in indicators before and after psychological correction using the Student's formula and table.

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5.2. Methodology of theoretical substantiation of the development of endotoxicosis after psychological correction

Justification of the formation of toxins as a result of PS and psychotrauma

For the theoretical substantiation of the formation of toxins as a result of PS exposure and the consequences of psychotrauma, the data given in the scientific literature was used:

1. Classic stress response;
2. Modern lifestyle and characteristics of the reaction to PS
3. Formation of endotoxins in PS and psychotrauma induced by it.
4. Features of endogenous intoxication after psychocorrection.

6. Findings

6.1. Diagnostics of endotoxicosis after psychological correction

The study of the dynamics of the level of MM in the blood showed that in all cases, in the morning, before food and water intake, the level was significantly lower than in the evening at 18.00. At the same time, the indicators in the evening compared with the standard level of the morning of the 1st day (100%) were: on the 1st day –178.6 ± 6.3%, on the 2nd day –181.7 ± 7.9%, on the 3rd day –173.8 ± 9.2% (table).

Table 01. Level of MM in blood before and after psychological correction

The studied indicators	MMP before psychocorrection (%)		MMP after psychocorrection (%)	
	Morning	Evening	After 3 hours	After 12 hours
1 day	100	$178.6\pm6.3^{\Delta}$	–	–
2 days	110.3±6.7	$181.7\pm7.9^{\Delta}$	–	–
3 days	98.6±5.4	$173.8\pm9.2^{\Delta}$	–	–
3 days (evening) Psychocorrection	–	100%	$172.8\pm16.5^{\Delta}$	$316.4\pm21.7^{\Delta}$

Note: $^{\Delta}$ is the reliability of the difference from the standard indicators

Within 3 days, there were no significant differences between the morning indicators (P> 0.05). At the same time, against the background of the general trend towards a significant increase in the content of MM in the blood in the evening (P <0.05), the evening indicators did not differ significantly among themselves on days 1, 2, and 3 (P> 0.05).

The indicators of MM in the evening of the 3rd day (6 pm) when interpreting the results after psychological correction were considered as normative and were taken as 100%.

It was found that in the evening of the 3rd day after the start of the study program at 18:00 MM the indicators significantly exceeded the standard (P <0.05).

After psychological correction, blood samples were taken 3 hours later to determine the level of MM. It was found that 3 hours after the correction, the level of MM increased in comparison with the evening indicators on the 3rd day, which were taken as standard by 72.8 ± 8.5%, that is, 3 hours after psychological correction, it significantly increased and amounted to 172.8 ± 8.5% (P <0.05).

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Moreover, instead of a decrease in the level of MM in the morning of the next day after psychological correction, it significantly increased not only in comparison with the standard in the evening at 6 p.m. ($P < 0.05$), but also in comparison with the results recorded 3 hours after the therapy was carried out ($P < 0.05$).

In addition, against the background of an increase in MM in the blood after psychological correction, 40 (83.3 ± 5.4%) participants demonstrated both psychological (emotional lability, lethargy, tearfulness, emptiness, aggression) and clinical (somatic) symptoms (lethargy, apathy, headaches, pain, drowsiness, tachycardia, dry mouth and thirst) of endotoxicosis.

Thus, against the background of a sharp increase in toxic MM in the blood after psychological correction accompanied by an intense emotional reaction, more than 80% of people developed symptoms of endogenous intoxication within 1 day. An increase in the level of markers of endogenous intoxication after psychological correction indicates that against the background of psychotrauma, the products of anaerobic catabolism accumulate and are deposited in the body. Accordingly, the psychophysiological substantiation of the consistent patterns of this phenomenon is important.

6.2. Justification of the development of endogenous intoxication after psychocorrection

In the teachings of Selye (1936) on the general adaptation syndrome, the response to stress involves the development of standard, consistently implemented biological reactions of the body to maintain homeostasis. At the same time, the classic triad of stress was identified: hyperplasia of the adrenal cortex, degenerative changes in the thymus and the appearance of erosions-ulcers in the upper parts of the digestive tract.

That is, the effect of stress on the body leads to hyperfunction of the adrenal cortex and an increased release of catecholamines. The consequence of this is generalized angiospasm and impaired peripheral microcirculation.

Focusing on this triad, it was not mentioned that under stress, similar changes develop at the organismic level, but they are less noticeable (Salekhov, 2019d).

Modern lifestyle has changed the focus of stressors. At the same time, classical stress was transformed into PS directed to the central nervous system. An intense emotional response to a psychological stressor results in the release of catecholamines, adrenergic hormones, and activation of the sympathoadrenal system.

PS activates the sympatho-adrenal system, which leads to peripheral angiospasm and hypoxia. At the same time, the levels of glucose and cortisol increase, but the activity of insulin decreases and insulin resistance develops. That is, there is a priority supply of glucose to the central nervous system, which does not depend on insulin.

Against this background, an intense focus of priority excitation remains in the limbic system, reticular formation and amygdala, initiating the survival mechanism.

The fight-or-flight survival reaction activates due to intense motor activity, which has been minimized in modern society.

Moreover, adherence to socially acceptable norms and rules of behavior has led to “social immobilization”, which is realized through the “freeze” strategy. In this case, emotional activity is fully

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or partially suppressed, and the cognitive assessment of the situation is based on considering the most negative scenarios for the development of events and options for their solution.

Accordingly, the combination of activation of the sympathoadrenal system with peripheral angiospasm and systemic hypoxia with the blocking of emotional arousal leads to the interaction of humoral stress factors and receptors under conditions of oxygen starvation. This process can be called anaerobic catabolism. At the same time, the number of intermediate toxic anaerobic metabolites increases, some of which are deposited in organs and tissues in the area of their formation.

Against the background of activation of the emotional-figurative memory of psychotrauma and a stagnant focus of excitation in the central nervous system associated with psychotrauma, the experience of a previously transferred stressful situation occurs. In this case, peripheral receptors are activated and endotoxins deposited after primary psychotrauma are released. It leads to the development of endogenous neurointoxication in the post-correctional period.

Accordingly, it is advisable to develop and carry out activities aimed at preventing and correcting endotoxicosis after psychological interventions.

7. Conclusion

Analysis of the results of the dynamics of MM in the blood showed that after psychological correction there was a significant increase in their levels, which in more than 80.0% of cases was accompanied by psychological and somatic manifestation of endotoxicosis.

The reaction to psychological stress has its own characteristics, but it is accompanied by activation of the sympatho-adrenal system, peripheral angiospasm, an increase in blood cortisol and glucose in conditions of insulin resistance development, as well as hypocapnia. It is clear that these conditions are created at the organismal level for the transition to anaerobic catabolism. This is aggravated by social immobilization, which reduces the ability of aerobic utilization of stress hormones and metabolic intermediates. The consequence of this is the formation of endogenous toxins, which are partially deposited in the peripheral tissues.

Psychological correction with an intense emotional reaction during the experience of trauma leads to the activation of peripheral receptors and the flow of endotoxins into the blood. The consequence of this is the development of endotoxicosis. The results obtained make it possible to approach an understanding of the psychophysiological features of the activation of psychological and somatic symptoms after psychological correction and the development of measures aimed at neutralizing endotoxicosis. It is promising to continue research in this direction.

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