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CORRECTION OF PSYCHOSOMATIC STATUS IN VETERANS DURING THE EARLY REHABILITATION STAGE AFTER COMBAT INJURY: A CROSS-SECTIONAL STUDY

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Introduction. The prevalence of long-term psychosomatic consequences of combat stress and combat injury (up to 48.3% three years later) justifies the relevance of identifying targets for psychosomatic status correction already during the early rehabilitation stage. Numerous reports of hyperactivation of the sympathoadrenal and hypothalamic-pituitary-adrenal systems as a central pathophysiological link in excessive allostatic load and the breakdown of adaptation emphasize the need to consider autonomic disorders as an independent target for psychological and psychophysiological intervention.

Objective. To substantiate autonomic dysregulation as a target for correcting psychosomatic status within a psychological intervention framework during early rehabilitation in veterans who sustained combat injuries.

Materials and methods. The study included 54 male combat veterans aged 18–55 years (mean age: 29 ± 9.3 years) with documented front-line exposure of at least six months. Assessments were performed on postoperative days 3–5 following surgery for combined blast-induced injuries. Based on the severity of post-traumatic symptoms, participants were stratified into three groups: Group 1 ($n = 20$, 38%): no symptoms; Group 2 ($n = 22$, 40%): subclinical symptomatology; Group 3 ($n = 12$, 22%): pronounced symptomatology. The study used psychodiagnostic testing and assessment of the functional state of the autonomic nervous system based on heart rate variability parameters, performed by variational cardiointervalometry (UPFT-1/30 Psychophysiolgist). Mathematical and statistical processing of the results was performed using the Statgraphics Plus statistical software package.

Results. The intensification of post-traumatic stress reactions occurs against the background of exacerbation of neurotic and somatic complaints. The predominance of the central regulatory circuit is a key pathogenetic mechanism in the development of psychosomatic disorders. Direct correlations were found between the intensity of somatic complaints and the degree of psychological maladaptation ($r = 0.978$, $p \leq 0.01$). It was established that 100% of military personnel with a high level of psychological adaptation (≤ 70 points) had types I and II of autonomic regulation (predominance of the central circuit). Comprehensive assessment of their autonomic status suggests the transformation of mental symptomatology into autonomic nervous system dysregulation, which at this stage is detectable only by instrumental methods. The increased tension of regulatory systems and enhanced activity of stress-implementing systems of autonomic regulation in this group of patients directly correlate with inverted anxiety ($r = 0.671$, $p \leq 0.01$) and conversion ($r = 0.493$, $p \leq 0.01$) scales, indicating compensatory hyperactivation of the central regulatory circuit as a physiological basis for maintaining a state of psychological well-being.

Conclusions. Psychological maladaptation and somatic complaints are pathodynamically associated with vegetative dysregulation. The system of early psychological intervention during the inpatient rehabilitation stage should be aimed at preventing the development of delayed psychosomatic disorders and should be structured taking into account the severity of post-traumatic symptomatology and the functional state of the autonomic nervous system. In addition to routine psychodiagnostic methods, functional assessment of the autonomic nervous system is recommended. Mandatory cognitive behavioral psychotherapy, as prescribed by current clinical guidelines, should be complemented by psychophysiological rehabilitation interventions aimed at restoring vagosympathetic balance.

Keywords: psychosomatic status; variational cardiointervalometry; combat veterans; combat injury; vegetative dysregulation; early psychological intervention; post-traumatic stress disorder

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КОРРЕКЦИЯ ПСИХОСОМАТИЧЕСКОГО СТАТУСА У ВЕТЕРАНОВ НА ЭТАПЕ РАННЕЙ РЕАБИЛИТАЦИИ ПОСЛЕ ПОЛУЧЕНИЯ БОЕВОЙ ТРАВМЫ: КРОСС-СЕКЦИОННОЕ ИССЛЕДОВАНИЕ

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Введение. Распространенность отдаленных психосоматических последствий боевого стресса и боевой травмы (до 48,3% спустя 3 года) обосновывает актуальность поиска мишеней коррекции психосоматического статуса еще на этапе ранней реабилитации. Многочисленные упоминания о гиперактивации симпатoadреналовой и гипоталамо-гипофизарно-надпочечниковой систем как центрального патофизиологического звена избыточной аллостатической нагрузки и срыва адаптации подчеркивают необходимость рассмотрения вегетативных нарушений в качестве самостоятельной мишени для направленного психологического и психофизиологического вмешательства.

Цель. Обоснование вегетативной дисрегуляции в качестве мишени коррекции психосоматического статуса в системе психологического вмешательства на этапе ранней реабилитации у ветеранов, получивших боевую травму.

Материалы и методы. Исследование проведено с участием 54 ветеранов боевых действий (нахождение на линии боевого соприкосновения не менее 6 месяцев; мужчины в возрасте 18–55 лет; средний возраст $29,0 \pm 9,3$ года) на 3–5-е сутки после хирургического вмешательства по поводу сочетанной минно-взрывной травмы. В зависимости от степени выраженности посттравматической симптоматики исходная выборка была распределена на 3 группы: группа 1 ($n = 20$), 38% — отсутствие симптомов; группа 2 ($n = 22$), 40% — субклиническая симптоматика; группа 3 ($n = 12$), 22% — выраженная симптоматика. В работе использовались психодиагностическое тестирование и оценка функционального состояния вегетативной нервной системы по показателям вариабельности сердечного ритма, выполненная методом вариационной кардиоинтервалометрии (УПФТ-1/30 «Психофизиолог»). Математико-статистическая обработка результатов осуществлена с помощью пакета статистических программ Statgraphics Plus.

Результаты. Усиление посттравматических стрессовых реакций происходит на фоне обострения невротических и соматических жалоб. Преобладание центрального контура регуляции является ключевым патогенетическим механизмом в развитии психосоматических расстройств. Обнаружены прямые корреляционные связи между интенсивностью соматических жалоб и степенью психологической дезадаптации ($r = 0,978$, $p \leq 0,01$). Установлено, что 100% военнослужащих с высоким уровнем психологической адаптации (≤ 70 баллов) имели I и II типы вегетативной регуляции (преобладание центрального контура). Комплексная оценка их вегетативного статуса позволяет предположить трансформацию психической симптоматики в дисрегуляцию ВНС, диагностируемую на данном этапе только инструментально. Усиление напряжения регуляторных и повышение активности стресс-реализующих систем вегетативной регуляции у них прямо коррелируют с инвертированными шкалами тревоги ($r = 0,671$, $p \leq 0,01$) и конверсии ($r = 0,493$, $p \leq 0,01$), что указывает на компенсаторную гиперактивацию центрального контура регуляции как физиологической опоры поддержания состояния психологического благополучия.

Выводы. Психологическая дезадаптация и соматические жалобы патодинамически сопряжены с вегетативной дисрегуляцией. Система раннего психологического вмешательства на госпитальном этапе реабилитации должна быть направлена на профилактику развития отсроченных психосоматических расстройств и выстраиваться с учетом выраженности посттравматической симптоматики и функционального состояния ВНС. Целесообразно кроме привычных психодиагностических методик проводить функциональную оценку вегетативной нервной системы и дополнять обязательную в соответствии с действующими клиническими рекомендациями когнитивно-поведенческую психотерапию методами психофизиологической реабилитации, направленными на нормализацию вагосимпатического баланса.

Ключевые слова: психосоматический статус; вариационная кардиоинтервалометрия; ветераны боевых действий; боевая травма; вегетативная дисрегуляция; раннее психологическое вмешательство; посттравматическое стрессовое расстройство

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INTRODUCTION

The magnitude of the psychosomatic consequences of combat injury determines the urgent need to develop preventive strategies aimed at reducing the risk of development and progression of these disorders in combat veterans in the long term [1, 2]. The results of recent studies have shown that three years after experiencing combat stress, the prevalence of psychosomatic disorders and conditions among veterans reaches approximately 48.3% [3].

The conventional approach to patient therapy artificially separates mental and somatic disorders, treating the latter as concomitant pathology. As a result, somatoform manifestations are managed in isolation, without integration into a comprehensive system of psychotherapeutic and psychopharmacological correction. Such separation creates a harmful therapeutic delay. Specific intervention aimed at stabilizing the autonomic sphere is initiated post factum, only after the official confirmation of post-traumatic stress disorder (PTSD), which requires a latent period of six months.

The currently accepted approach to the management of patients with PTSD (ICD-10 code F43.1) treats somatic disorders as concomitant pathology requiring independent symptomatic and etiopathogenetic therapy. As a result, autonomic and later psychosomatic disorders are often treated in isolation, without addressing the underlying mental state. Consequently, valuable time is lost, as targeted interventions to correct the psychosomatic status typically begin only six months after the PTSD diagnosis has been established in accordance with diagnostic criteria. However, somatization and disturbances in autonomic nervous system (ANS) regulation develop immediately after injury. As shown by Sukiasyan et al., the clinical development of PTSD from "irritable heart syndrome" to profound psychogenic-organic disorders indicates that the mental and somatic spheres are affected simultaneously [4]. This confirms the conclusion by Simaeva and Pukhova that psychological support in extreme situations should be continuous to halt the development of pathology at its earliest stages, rather than after symptoms have become established [5]. Therefore, the development of methods for timely prevention and correction of autonomic disorders at early (sometimes pre-nosological) stages remains one of the most important tasks of clinical psychology and medicine.

The severe conditions of combat environment cause extreme neuropsychic tension in military personnel, which must be assessed in clinical practice [6]. The mechanisms of brain function provide an instantaneous connection between thoughts of threat, emotions, and physical reactions of the body. According to Chernorizov et al., sustained elevation of the blood concentration of cortisol, the stress hormone, leads to changes in the activity of neural networks of the hippocampus, amygdala, and prefrontal cortex, which explains the persistence of emotional memory traces of the traumatic event

and the emergence of associated mental disorders [7]. This process is driven by hyperactivation of the hypothalamic-pituitary-adrenal and sympathoadrenal systems. According to Jowf et al., such a prolonged hormonal shift creates an excessive allostatic load, which leads to depletion of adaptive resources and triggers the development of PTSD [8]. The chronic course of this process leads to persistent changes in brain structures [9]. Analyzing combat stress, Karayani classifies its manifestations into acute stress reactions, combat mental trauma, and chronic fatigue, which makes it possible to clearly distinguish between normal and pathological responses of the organism [10]. The aforementioned factors profoundly alter the emotional sphere of military personnel [11], thereby determining the development of somatic diseases. In particular, Potemina et al. described combat-stress-associated disorders of the cardiovascular system in veterans, emphasizing that, during the first three years after combat stress exposure, various manifestations of autonomic dysfunction (cardiac rhythm disturbances, blood pressure lability, respiratory disorders, gastrointestinal disorders) predominate in combination with affective disorders, mainly of the anxiety-depressive spectrum [3, 12]. Harwood-Gross et al. showed that extreme loads are directly related to the severity of subsequent somatization and aggressive behavior [13]. In this regard, the study by Gurylev et al. emphasizes that monitoring the psychoemotional state of military personnel should be a mandatory element in their medical rehabilitation programs [14].

Given the close link between combat stress and cardiovascular and somatoform disorders, a detailed study of vegetative dysregulation becomes a crucial task of medical-psychological support for combatants. Assessment of this pathophysiological link allows autonomic disorders to be considered as an independent target for psychological intervention during the early stages of medical rehabilitation.

In the case of delayed or ineffective early psychological intervention, pathological psychosomatic patterns may develop and become established quite rapidly, creating a vicious circle in which somatic symptoms exacerbate psychological maladaptation and vice versa [1]. Early psychocorrection is aimed at breaking this circle at the stage of reversible psychosomatic reactions and reducing the risks of manifestation of the full spectrum of PTSD-associated psychosomatic diseases (psychosomatoses, psychovegetative disorders, syndromes of psychosomatic affiliation and dissociation) [2, 12, 13]. Practical difficulties may include low engagement of combatants in therapy, a tendency to disregard complaints [14], as well as difficulties for specialists in identifying psychological targets for such correction. Traditionally, the development of psychosomatic diseases in PTSD has been viewed through the concept of transformation, according to which psychopathological symptomatology intensifies during the first six months and only then somatization may occur via biological or

psychopathological mechanisms. This perspective may cause psychologists and physicians to underestimate the importance of addressing psychosomatic complaints at the earliest stages of rehabilitation.

Although ICD-10 does not mention psychosomatic manifestations as diagnostic criteria for PTSD (except for increased autonomic excitability), from a systems perspective, psychosomatic disorders are an integral pathogenetic part of PTSD, reflecting its somatic embodiment [15]. In a strict clinical sense, PTSD and psychosomatics develop simultaneously. There is no “pure” PTSD without physiological changes (tachycardia, sleep disturbances, muscle hypertonicity), just as there are no post-traumatic psychosomatic disorders without a psychological core (flashbacks, avoidance). At the same time, somatization through biological mechanisms is based on persistent dysregulation of the sympathoadrenal and hypothalamic-pituitary-adrenal systems, while somatization through psychopathological mechanisms is based on an unconscious defense mechanism of “escape into illness,” which represents a socially acceptable adaptation mechanism. Thus, according to current clinical concepts, PTSD is viewed as a multifactorial condition requiring comprehensive and phased psychotherapeutic intervention aimed at reducing the severity of post-traumatic symptomatology and restoring adaptive behavior [4, 16]. According to Chernorizov et al., psychophysiological methods are indispensable in situations where patients do not trust conventional medical tactics or show insensitivity to standard therapy [7].

In accordance with the approved clinical guidelines¹, in order to reduce the risk of developing PTSD, anxiety and depressive disorders (which may manifest within 12 months after discharge from the intensive care unit (ICU)), patients are recommended to receive early psychological intervention (by a clinical psychologist and/or psychotherapist) in the intensive care unit. Rehabilitation measures should be aimed at developing or restoring insufficient or lost cognitive, motivational, emotional, and adaptive resources of the personality through psychocentered supportive psychotherapeutic methods, including interventions supporting compliance, psychoeducation, and cognitive-behavioral psychotherapy.

The study is based on the hypothesis that the formation of psychosomatic reactions occurs almost immediately, within the first few days after combat injury, and varies depending on the severity of post-traumatic symptomatology and the type of autonomic regulation. Vegetative dysregulation, manifested by excessive centralization of heart rate control, is a common mechanism of somatization that triggers a cascade of somatic and neurotic manifestations; however, in some cases it may act as a hypercompensatory response that preserves psychological well-being but depletes psychophysiological reserves.

The aim of the study is to provide a rationale for vegetative dysregulation as a target for psychosomatic status correction in the system of early psychological intervention in veterans with varying severity of post-traumatic symptomatology at the early rehabilitation stage after combat injury.

MATERIALS AND METHODS

The study was conducted with the participation of 54 combat veterans (engagement on the line of combat contact for at least six months; males aged 18–55 years; mean age 29 ± 9.3 years). The work was carried out at the Federal Siberian Scientific Clinical Center in inpatient units temporarily deployed for the provision of specialized, including high-technology, medical care. The examination was conducted in the early postoperative period (days 3–5) after surgical intervention for combined blast-induced injury at the inpatient stage of medical rehabilitation, with voluntary informed consent of the subjects.

Depending on the severity of post-traumatic stress symptoms according to the Mississippi Scale, the initial sample was divided into three groups:

- group 1 ($n = 20$), 38% of participants, PTSD ≤ 70 points;
- group 2 ($n = 22$), 40% of participants, $70 < \text{PTSD} \leq 100$ points;
- group 3 ($n = 12$), 22% of participants, $100 < \text{PTSD}$ points.

Inclusion criteria were male sex, age 18–55 years inclusive, presence of a recent (less than 2 weeks) combat-related combined blast-induced injury (CBII) requiring emergency surgical intervention, early postoperative period (days 3–5 from the time of surgical intervention), absence of signs of delirious states or cognitive impairment preventing understanding of instructions, at the inpatient stage of medical rehabilitation, and voluntary written informed consent of the subjects.

Exclusion criteria were the presence of a verified current or past diagnosis from rubric F43.1 (“Post-traumatic stress disorder”) or other endogenous and organic mental disorders (F00–F99) according to ICD-10; concomitant moderate or severe traumatic brain injury (cerebral contusion, intracranial hematomas); severe traumatic or hemorrhagic shock in the decompensation stage; history of severe chronic somatic and endocrine diseases that could distort heart rate variability parameters (type I and II diabetes mellitus, coronary artery disease, cardiac rhythm disorders); thyroid pathology; use of medications with direct chronotropic or ganglionic blocking effects (β -blockers, antiarrhythmics); non-constant type of autonomic regulation based on all measurement results.

Assessment of the functional state of the autonomic nervous system based on heart rate variability parameters was performed by means

¹ Post-traumatic stress disorder. Clinical guidelines. Russian Society of Psychiatrists, Ministry of Health of the Russian Federation. 2023.

of variational cardiointervalometry using an UPFT-1/30 “Psychophysiological” psychophysiological testing device (Medicom MTD, Russia) [17]. For the detection and assessment of neurotic states, psychodiagnostic testing was performed using the Yakhin–Mendelevich questionnaire²; screening for post-traumatic symptomatology was carried out using the Mississippi Scale for Combat-Related PTSD (military version) [18]; diagnosis and assessment of somatic symptoms and complaints related to psychological and emotional states were performed using the Giessen Complaint List (Gießener Beschwerdebogen, GBB)³.

Analysis of heart rate variability parameters was conducted in accordance with the Russian methodological guidelines⁴. To minimize the influence of situational and diurnal exogenous factors, the examination was carried out strictly in the morning hours on an empty stomach, under conditions of thermal comfort, after a 10-min adaptation period in a semi-recumbent position. The protocol included three consecutive 5-min measurements, followed by averaging of the data obtained to exclude random rhythm fluctuations. To ensure reliability of the results, cardiointervalogram recordings containing more than 10% artifacts (isolated extrasystoles, technical failures) or demonstrating abnormal values of total spectral power indicating incorrect registration (e.g., $TP > 16,000 \text{ ms}^2$) were excluded from further mathematical and statistical analysis of autonomic status. From the entire set of obtained time-domain and frequency-domain HRV characteristics, the following were analyzed: SI (stress index) that characterizes the activity of sympathetic regulation mechanisms and the state of the central regulatory circuit; TP (total spectral power) that shows the total effect of all regulatory levels on heart rate; LF (power of low-frequency waves (0.15–0.04 Hz)) that reflects the activity of sympathetic centers of the medulla oblongata (cardiostimulatory and vasoconstrictor); HF (power of high-frequency waves (0.4–0.15 Hz)) that expresses the activity of the parasympathetic cardioinhibitory center of the medulla oblongata; VLF (power of very low-frequency waves (0.04–0.0033 Hz)) that reflects the activity of central ergotropic and humoral-metabolic regulatory mechanisms of heart rate; LF/HF as the vagosympathetic balance coefficient [19].

Mathematical and statistical processing of the results was performed using the Statgraphics Plus statistical software package. The establishment of relationships between the studied parameters was conducted via correlation analysis using Spearman’s rank correlation coefficient; to assess differences among three independent groups, the *H*-test (non-parametric Kruskal–Wallis test) was applied.

RESULTS AND DISCUSSION

At the first stage of the study, to assess the level of psychological instability against the background of experienced combat stress and blast-induced injury, the severity of post-traumatic reactions was examined using the Mississippi Scale for Combat-Related PTSD (military version). It should be clarified that at the time of the study, no veteran had been assigned an ICD-10 diagnosis of F43.1 “Post-traumatic stress disorder.” Depending on the degree of psychological distress based on the total Mississippi Scale score, it was found that 20 (38%) patients had a low level of post-traumatic symptomatology (score ≤ 70), 22 (40%) patients had a moderate (subclinical) level of post-traumatic symptomatology with signs of psychological maladaptation (score 71–100), and 12 (22%) participants showed a clinically significant level of post-traumatic symptomatology with pronounced psychological maladaptation (score > 100). In the majority of the injured — 34 (62%) participants (together constituting groups 2 and 3) — the obtained score exceeded the diagnostically significant threshold of 70 points, of which 12 (35%) patients had a score exceeding 100 points, indicating pronounced psychological maladaptation. Differences in the indicators of autonomic nervous system adaptive potential, neurotic states, and somatic complaints depending on the level of post-traumatic stress are presented in the table.

Analysis of intergroup differences revealed a pronounced nonlinearity in the response of regulatory systems. The highest indicators of physiological tension (SI 318.5 ± 74.8 arbitrary units) and a critical drop in total spectral power at the level of $1329 \pm 307.7 \text{ ms}^2$ were recorded in combat veterans of group 3, reflecting a classic breakdown of adaptation and depletion of trophotropic mechanisms against the background of stress manifestation. Participants in group 1 (conditionally psychologically adapted) demonstrated a paradoxically high level of stress index — 230.5 ± 28.7 , significantly exceeding that of group 2 ($p \leq 0.05$ in pairwise comparison), despite the complete absence of neurotic or somatic complaints according to psychodiagnostic results. For further clarification of autonomic status, respondents within each group were classified by type of autonomic regulation based on SI and VLF indicators in accordance with the classification proposed by Shlyk [20] (Fig. 1).

A clear pathogenetic pattern was revealed: the groups at the edges of the clinical spectrum (1 and 3) in 100% of cases were characterized by centralization of rhythm control (types I and II), with group 3 showing a predominance of pronounced central regulatory circuit in 8 (66%) cases. In contrast, exactly half of the subjects — 11 (50%) from group 2 with moderate stress

² Yakhin KK, Mendelevich DM. Clinical questionnaire for the detection and assessment of neurotic states: Methodological recommendations for interns and physicians. Kazan: Kazan State Medical Institute; 1978 (In Russ.).

³ The use of the Giessen Complaint List in the clinic of borderline neuropsychiatric and psychosomatic disorders: A methodological guide. St. Petersburg: Psychoneurological Institute; 1993 (In Russ.).

⁴ Baevsky RM, Ivanov GG, Chireikin AP, Gavrilushkin PY, Dovgalevsky YA, Kukushkin TF, et al. Analysis of heart rate variability using various electrocardiographic systems (part 1). *Journal of Arrhythmology*. 2002;24:65–86 (In Russ.).

Table. Parameters of autonomic status, neurotic and somatic complaints in veterans depending on the severity of post-traumatic symptomatology

Assessed parameters	Group 1 (n = 20) PTSD ≤ 70	Group 2 (n = 22) 70 < PTSD ≤ 100	Group 3 (n = 12) PTSD ≥ 100	Statistical significance level
PTSD Level (Mississippi Scale), Scores	60.5 ± 9.6	79.2 ± 7.3	109.9 ± 6.4	$p \leq 0.01$
Heart Rate Variability (HRV) parameters				
IN (SI), arbitrary units (a.u.)	230.5 ± 28.7	130 ± 25.13	318.5 ± 74.8	$p \leq 0.01$
TP, ms ²	2578.6 ± 716.3	3312 ± 1078.3	1329 ± 307.7	$p \leq 0.05$
HF, ms ²	369.5 ± 112.1	429.3 ± 108.3	153.2 ± 16.28	$p \leq 0.01$
LF, ms ²	1035.4 ± 310.04	1056.2 ± 314.8	557.4 ± 52.5	$p \leq 0.05$
VLF, ms ²	1173.6 ± 218.5	1659.5 ± 264.2	418.4 ± 215.2	$p \leq 0.01$
LF/HF, scores	3.77 ± 1.6	3.42 ± 1.13	4.79 ± 2.07	$p \leq 0.05$
Neurotic symptomatology				
Anxiety level	4.8 ± 2.2	-0.03 ± 0.6	-3.36 ± 2.12	$p \leq 0.01$
Neurotic depression	4.4 ± 0.8	0.97 ± 0.3	-4.3 ± 2.6	$p \leq 0.01$
Asthenia	7.1 ± 3.6	1.58 ± 0.92	-0.47 ± 0.54	$p \leq 0.01$
Conversion disorders	3.2 ± 1.4	-0.35 ± 0.27	-3.17 ± 1.48	$p \leq 0.01$
Obsessive-phobic disorders	3.13 ± 1.6	0.45 ± 1.13	-4.12 ± 3.8	$p \leq 0.01$
Vegetative symptom complex	5.3 ± 4.12	-2.9 ± 1.3	-11.69 ± 3.4	$p \leq 0.01$
Somatic complaints⁵				
Exhaustion	4.25 ± 1.3	6.8 ± 2.4	7.4 ± 2.2	$p \leq 0.05$
Gastrointestinal complaints	1.75 ± 0.4	3.7 ± 1.6	9.6 ± 3.8	$p \leq 0.01$
Rheumatic factor	9.4 ± 3.3	14.5 ± 5.1	15.07 ± 6.5	$p \leq 0.05$
Cardiovascular complaints	3.35 ± 2.6	3.8 ± 1.5	10.53 ± 3.6	$p \leq 0.01$
Intensity of complaints	18.75 ± 6.3	28.9 ± 5.8	42.3 ± 7.7	$p \leq 0.01$

Table prepared by the authors using their own data

Note. SI — stress index; TP — total spectral power; HF — high-frequency wave power (0.4–0.15 Hz); LF — low-frequency wave power (0.15–0.04 Hz); VLF — very low-frequency wave power (0.04–0.0033 Hz); LF/HF — vagosympathetic balance coefficient; data are presented as arithmetic mean ± standard error of the mean ($M \pm m$); statistical significance of differences was calculated using the non-parametric Kruskal–Wallis H -test for multiple comparison of three or more groups (critical significance level set at 0.05).

levels — retained the physiologically “advantageous” type III of autonomic regulation. This indicated the activation of a compensatory “vagal brake” (within the framework of Porges’ polyvagal theory), capable of temporarily protecting the organism from sympathoadrenal exhaustion at the stage of moderate maladaptation, whereas the latent tension noted in patients of group 1 and the pronounced manifestation (in participants of group 3) completely block this resource. The association between the level of psychological distress and the intensity of somatization is also confirmed by the results of correlation analysis (Fig. 2).

Analysis of the obtained data showed that the intensification of post-traumatic symptoms was accompanied by increasing neurotic and somatic complaints. A high comorbidity of post-traumatic symptoms with neurotic depression ($r = -0.475$, $p \leq 0.05$), obsessive-phobic reactions ($r = -0.418$, $p \leq 0.05$), and asthenia ($r = -0.447$, $p \leq 0.05$) was found in group 2, as well as with vegetative ($r = -0.775$, $p \leq 0.01$) and psychosomatic reactions in group 3 (Fig. 2). The pathogenetic mechanisms of the influence of autonomic status on the manifestation of neurotic, somatic, and post-traumatic symptom complexes were characterized by multilevel systemic

⁵ The use of the Giessen Complaint List in the clinic of borderline neuropsychiatric and psychosomatic disorders: A methodological guide. St. Petersburg: Psychoneurological Institute; 1993 (In Russ.).

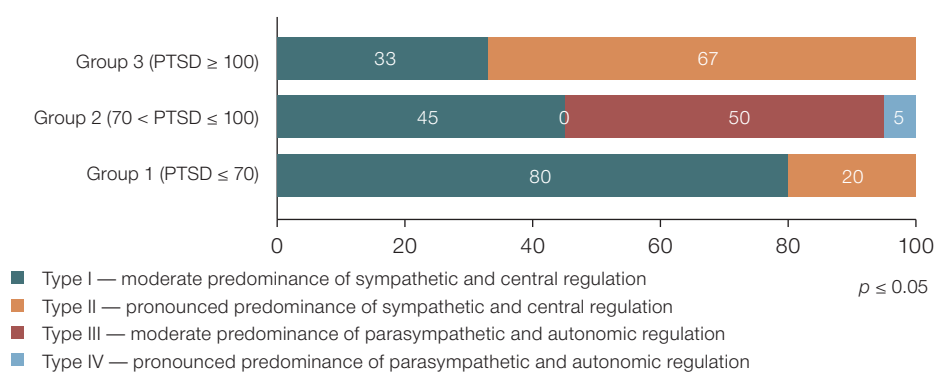


Figure prepared by the authors using their own data

Fig. 1. Distribution of participants with varying severity of post-traumatic symptoms by types of autonomic regulation according to Shlyk's classification. PTSD — severity of post-traumatic symptomatology

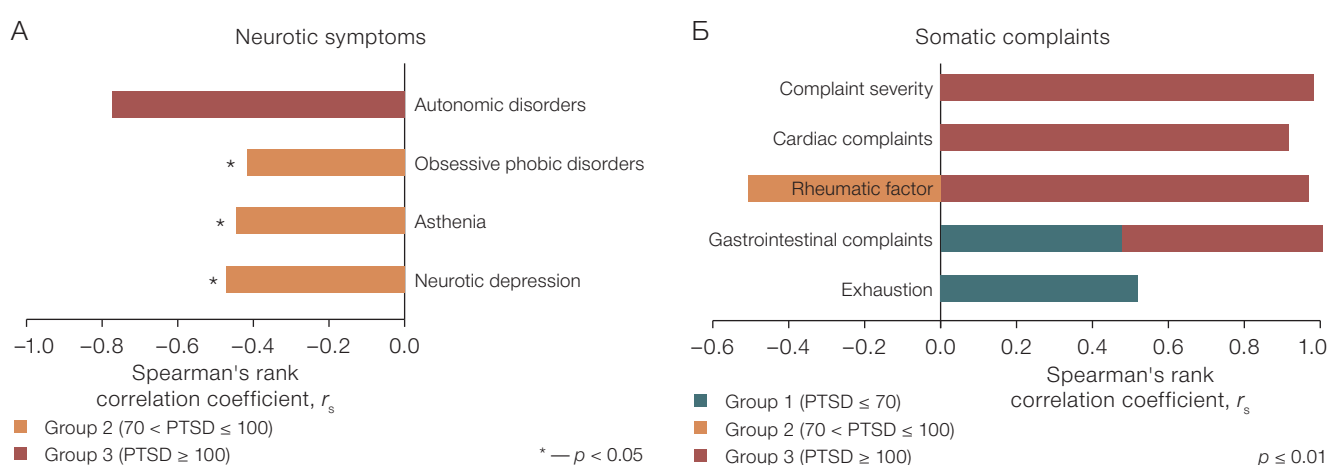


Figure prepared by the authors using their own data

Fig. 2. Relationship between the severity of neurotic symptoms (A) and psychosomatic complaints (B) in veterans with different levels of psychological maladjustment. $p < 0.01$; * — $p < 0.05$

organization and the absence of a direct proportional relationship. Thus, representatives of groups 1 and 3, with type I or II autonomic regulation in 100% of observations, can be considered the most vulnerable category from the standpoint of developing psychosomatic pathology (for comparison, in respondents of group 3, type III autonomic regulation, which is optimal and characterized by "economical" functioning of the cardiovascular system [21], was diagnosed in 50% of cases). The predominance of the sympathetic link of regulation in groups 1 and 3 was also evidenced by the mean values of the LF/HF coefficient, which determines vagosympathetic balance and is one of the prognostically significant indicators (in cases where its value exceeds 3 ms²) for assessing the risks of developing irreversible organic disorders (true psychosomatic diseases) due to prolonged functioning of the organism under conditions of internal stressor tension [21].

The greatest scientific and clinical interest was associated with participants of group 1. Although these respondents did not report subjective anxiety or pain,

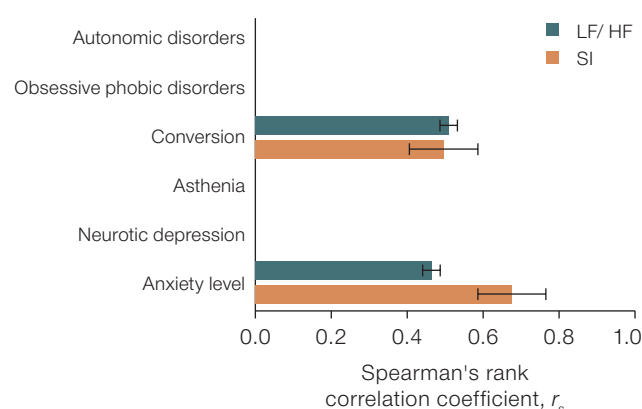


Figure prepared by the authors using their own data

Fig. 3. Relationship between the indicators of regulatory system tension and vagosympathetic balance and the severity of neurotic symptomatology in combat veterans with low levels of post-traumatic stress disorder ($n = 20$). SI — stress index; LF — power of low-frequency waves (0.15–0.04 Hz); HF — power of high-frequency waves (0.4–0.15 Hz)

demonstrating “ideal” test results, the absence of typical neurotic and somatic complaints in veterans with a predominance of the central regulatory circuit may not necessarily indicate the state of complete well-being. Rather, it may reflect a specific transformation of mental symptomatology (Fig. 3).

Analysis of the obtained correlations indicates the presence of a phenomenon of compensatory hyperactivation of the central circuit. In particular, increased activity of stress-implementing systems of autonomic regulation (SI index) was directly correlated with inverted anxiety ($r = 0.671$, $p \leq 0.01$) and conversion ($r = 0.493$, $p \leq 0.01$) scales. In other words, the intensification of regulatory system tension to some extent “contained” the development of neurotic and post-traumatic symptomatology. At the same time, chronic activation of central autonomic centers and their exhaustion may lead to a decrease in interoception and the ability to recognize anxiety, tension, pain, or autonomic symptoms. As a result, while subjective emotional complaints remain limited, discomfort may manifest differently. With pronounced central dysregulation, phenomena of depersonalization/derealization and behavioral detachment may arise, which reduce the conscious experience of symptoms and motivation to describe them. In addition, underreporting of symptoms associated with military cultural norms, which emphasize masculinity, restraint, and resilience, cannot be ruled out.

Underestimation of symptom severity in this case may reduce therapy effectiveness and adversely affect further adaptation [22]. The obtained data support the rationale for supplementing mandatory (in accordance with current clinical guidelines) cognitive-behavioral psychotherapy, eye movement desensitization and reprocessing (EMDR), and pharmacotherapy with psychophysiological rehabilitation aimed at improving the functional state of the ANS and normalizing vagosympathetic balance. In particular, these approaches include biofeedback therapy, audio-visual-vibrotactile stimulation (AVVS) therapy, autogenic training, conventional psychoregulatory means of recovery supplemented by mindfulness-based stress reduction (MBSR) therapy, breathing techniques with prolonged exhalation, grounding techniques, and progressive muscle relaxation. The latter are also aimed at stabilizing emotional state, reducing physiological hyperarousal, activating the parasympathetic branch of the autonomic nervous system, and creating a physiological basis for more effective subsequent cognitive-behavioral interventions [23]. Neuroimaging and psychophysiological studies confirm that regular practice of such techniques contributes to a decrease in amygdala activity and an enhancement of the regulatory role of the prefrontal cortex, which constitutes the neurobiological basis for reducing post-traumatic stress symptoms [16]. This is particularly important during the early rehabilitation stage, when patients may be yet unprepared for in-depth processing of

traumatic experience and may show skepticism, while simultaneously being in acute need of support and psychoeducation.

When developing a system of early psychological intervention, it is important to take into account possible difficulties in affect tolerance, which manifest as a sharp increase in anxiety, anger, or dissociative reactions during therapeutic sessions [10]. In such cases, premature use of exposure techniques may lead to intensification of symptomatology and deterioration of the overall condition. In turn, the development of basic self-regulation skills, psychoeducation, and training in self-help techniques at this stage may not only effectively complement pharmacotherapy for vegetative dysregulation, but also create a solid foundation for increasing tolerance to uncertainty and stress (including that associated with the need to integrate into civilian life, disability, etc.), social adaptation, adherence to cognitive behavioral therapy (CBT), and compliance in the future [24]. In addition to routine psychodiagnostic methods, functional assessment of the ANS by means of variational cardiointervalometry may be advisable. In respondents with “ideal” test results, alexithymia should be ruled out.

CONCLUSIONS

1. It was established that 62% of veterans at the early rehabilitation stage (days 3–5 after surgical treatment) following a recent (up to 14 days) blast-induced injury exceeded the diagnostically significant threshold of 70 points on the Mississippi screening scale for post-traumatic symptoms. In 35%, scores were 100 points or higher, indicating pronounced psychological maladaptation.
2. A pronounced predominance of the central regulatory circuit is a key pathogenetic mechanism in the development of psychosomatic disorders in veterans with combat injury. Differences in indicators of autonomic status, manifestation of neurotic symptomatology, and somatic complaints depend on the level of post-traumatic stress. In the groups at the extremes of the clinical spectrum (Mississippi Scale values below 70 or above 100 points), 100% of respondents exhibited centralization of rhythm control (types I and II of autonomic regulation), while 50% of veterans with moderate stress levels retained the physiologically “advantageous” type III regulation (moderate predominance of the autonomous circuit). The identified correlations confirm the advisability of considering autonomic profile indicators as an independent target for early psychological and psychophysiological interventions.
3. In all respondents with high indicators of psychological adaptation according to psychodiagnostic testing (38%), an atypical increase in the stress index of regulatory systems (SI) to a level of 230.5 ± 28.7 and a shift of vagosympathetic balance toward sympathetic activation (LF/HF) to 3.77 ± 1.6 were observed. The

absence of post-traumatic symptoms, as well as the direct correlation of the regulatory system stress index with inverted anxiety ($r = 0.671$, $p \leq 0.01$) and conversion ($r = 0.493$, $p \leq 0.01$) scales, indicate the presence of compensatory hyperactivation of the central circuit as a factor “containing” manifestations of psychological maladaptation.

4. The system of early psychological intervention in combat veterans at the inpatient rehabilitation stage after surgical treatment for combined blast-induced

injury should be structured with consideration of the already existing severity of post-traumatic stress and should be aimed at preventing the development of psychosomatic disorders in the long term. In this context, vegetative dysregulation serves as a promising therapeutic target for early psychological and psychophysiological interventions, particularly in combatants with an absence of post-traumatic symptomatology or with pronounced psychological maladaptation.

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