The possibility of using pictopolygraphy in the objective diagnosis of affective disorders

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The paper considers pictopolygraphic method in the objective diagnosis of affective disorders. 70 patients with symptoms of anxiety and depression were examined. Clinical psychopathologic and pictopolygraphic (by Software and Methodological Support Complex Egoscope) methods were implemented in the research. Pictopolygraphic method allows to carry out psychometric examination automatically using standardized questionnaires and scales while recording a number of physiological parameters: heart rate (HR), photoplethysmogram (PPG), electroencephalogram (EEG), galvanic skin response (GSR) and pictographic data. To assess the patient's subjective perception of the severity of anxiety and depressive disorders, the examinees completed the Hospital Anxiety and Depression Scale (HADS). It has been established that the assessment of the condition of patients with affective disorders based exclusively on clinical and psychopathological method is not sufficiently informative and does not always correspond to the actual severity of existing affective disorders. The use of the pictographic method in the examination of patients with anxiety-depressive disorders of a non-psychotic level can optimize the diagnostic process, improve the accuracy and quality of the diagnostic findings. The basic correlations of physiological pictographic indicators with patient complaints has been determined. It has been shown that the most informative and sensitive component of the objective assessment of patients with anxiety-depressive disorders is the change of the heart rate.

KEYWORDS: psychiatry; psychological diagnosis; affective disorders; anxiety; depression; pictopolygraphy; adaptation disorders; military personnel

ABBREVIATIONS:

HR – heart rate;
PPG – photoplethysmogram;
EEG – electroencephalogram;
GSR – galvanic skin response;
HADS – Hospital Anxiety and Depression Scale;
SES – semantic and emotional significance.

INTRODUCTION

The number of mental disorders, such as depression, has been growing for about the last 40 years in the developed countries. At the turn of the 21st century these disorders became "epidemic" [1, 2]. Anxiety-depressive disorders represent 40 per cent of the total world mental disorders and 20 per cent in Europe [3–5]. Moreover, nonpsychotic forms of these psychopathological disorders come to the fore in terms of prevalence.

An important point is that the so-called "major" depression demonstrates the maximum disability rate up to 10 per cent or even more. This indicator is more than two times higher than such common causes of disability as iron deficiency anemia, osteoarthritis and chronic obstructive pulmonary disease [6, 7]. Two obstacles to the provision of effective care explain high rates of disability in depressive disorders: untimely diagnosis of depression and the selection of inadequate therapy (or sometimes its absence) [6, 8].

The main task (currently unresolved) of the practicing psychiatrist is to make differential diagnosis of affective disorders in neurotic and endogenous depression. It is accepted that certain specific individual physiological parameters are associated with emotions. This makes instrumental and laboratory objectification of the emotional state possible.

Pictopolygraphic research is one of the most informative and accessible methods for diagnosing the emotional sphere by recording changes in the physiological parameters of the examined patient [8–11]. The use of this method in the diagnosis of mental disorders can increase the accuracy of diagnostic decisions [11–13].

The practical use of the pictographic approach indicates that a pure interpretation of the standard integral indicators of semantic and emotional significance in some cases leads to inaccurate conclusions. There are several reasons for that: cognitive impairment, motor inhibition, individual and personality characteristics of the patient, manifestations of the so-called adjustive behavior, etc. Therefore, when evaluating the results of a pictographic examination, the specialist must also take into account the interpretation of the individual components of the integral assessment of the semantic and emotional significance (SES) indices (semantic clusters, individual issues and physiological indicators).

To date there are almost no studies evaluating the most significant pictographic changes in anxiety and depressive disorders. These studies are of particular relevance in the framework of the so-called "precision medicine" focused on understanding the pathogenetic mechanisms of formation, clinical picture and dynamics of the disease in each patient.

AIM OF STUDY

The aim of the present study is to determine the characteristics of the pictopolygraphic indicators in patients with nonpsychotic affective disorders in order to increase the effectiveness of their differential diagnosis.

MATERIALS AND METHODS

The survey has been conducted at the psychiatry clinic of the Military Medical Academy named after S.M. Kirov (St. Petersburg) for four years (from 2014 to 2017). A total of 70 patients (male and female) were examined who underwent inpatient treatment for anxiety and depressive disorders. The average age of the examined individuals was 28.2 ± 8.3 years.

Exclusion criteria from the study:
1) depression on a psychotic level;
2) mental disorders in the framework of organic (symptomatic) lesions of the central nervous system;
3) the presence of various clinically expressed somatic pathology.

Diagnostic conclusions were formulated in accordance with ICD-10 (WHO, 1994). Features of the emotional and personal sphere and character accentuations were studied during the conversation based on the multilateral personality research – a version of the Minnesota Multiphasic Personality Inventory adapted by Berezin FB, et al. [14]. This technique was chosen due to the presence in its structure of scales F – "false" and C – "correction" making it possible to take into account the inaccuracy in answering questions and manifestations of aggravation. Special attention was paid to the patients with high rates (more than 70 T-points) on scales 3 (Hy) – "hysteria" and 4 (Pd) – "psychopathy", which indicated the presence of accentuation of the character of the hysterically-excitable type.

According to the preliminary results of the study group, it was divided into three groups depending on the clinical, psychopathological and etiopathogenetic features of the mental disorder detected in the patient:
1st group (n1 = 20) – patients with a depressive episode of moderate severity (endogenous depression) (F32.0 according to ICD-10);
2nd group (n2 = 25) – patients with adaptation disorder (prolonged depressive, mixed anxiety and depressive reactions) (F43.21, F43.22 according to ICD-10);
3rd group (n3 = 25) – patients with neurotic level of adjustment disorder (F43.21, F43.22 according to ICD-10) and concomitant hysterically-excitable character accentuation.

To assess the patient's subjective perception of the degree of severity of anxiety and depressive disorders the study group filled in the Hospital Anxiety and Depression Scale (HADS).

Objectification of the depressive and anxious experiences severity in the structure of the psychopathological syndrome was carried out on the basis of pictographic study. For this purpose, Software and Methodological Support Complex Egoscope (Medicom MTD Ltd., Taganrog, Russia) was used. It performs automated psychometric examination, using standardized questionnaires and scales while recording a number of physiological parameters: heart rate (HR), photoplethysmogram (FPG), electroencephalograms (EEG), galvanic skin reaction (RAG) and pictographic characteristics. The latter parameters were recorded with a touch-sensitive graphic tablet (degree of pressure on the pen, latent periods of responses, etc.).

Thus, the process of filling the HADS by patients was accompanied by the registration of a number of physiological parameters at Egoscope.

Based on an integrated assessment of the obtained physiological indicators, the SES index of the presented questions was calculated for every study subject. In accordance with the inherent hardware algorithm, the conclusion about the reliability of the HADS responses was made at $p < 0.05$, $p < 0.01$, and $p < 0.001$.

Statistical processing of the data obtained during the study was carried out, using the software package Statistika 10 and Microsoft Excel 2016. The differences were evaluated by nonparametric criteria: the Mann – Whitney U-test (for independent samples) and the Wilcoxon T-criterion (for dependent samples). The data obtained were presented in the form of $M ± \sigma$ (expected value ± standard deviation). The significance of the differences for percentages was determined by calculating the Pearson $\chi 2$ index. Spearman's rank correlation coefficient was also calculated.

RESULTS & DISCUSSION

The analysis of the phenomenological (clinical and psychopathological) characteristics of affective disorders in the study group has shown that patients of the 1st group did not find a relationship between the development of affective disorders and the impact of any significant external (including psycho-traumatic) factors. Patients of the 2nd and 3rd groups had neurotic pathology of the borderline level due to the impact of specific individually significant traumatic (stressful) events.

The results of the study indicated that the structure of the leading complaints by patients of the 2nd and 3rd groups was approximately similar. Complaints of mood decline (44% and 48%, respectively), depression (36% and 48%), sleep disturbance (52% and 36%), lack of motivation for activity (40% and 48%), anxiety predominated (44% and 44%), internal stress (36% and 40%), increased fatigue (52% and 48%). Significant differences in the frequency of occurrence of some complaints were found in patients of the 1st group:
    – in comparison with the 2nd group: decreased mood (90% and 44%; $p < 0.05$) and lack of motivation for activity (90% and 40%; $p < 0.01$);
    – in comparison with the 3rd group: decreased mood (90% and 48%; $p < 0.01$), sleep disturbances (75% and 36%; $p < 0.01$) and lack of motivation for activity (90% and 48%; $p < 0.01$).

It is to be noted that conducting differential diagnosis and making diagnostic conclusions based on the assessment of the phenomenological features of the studied mental disorders had their difficulties.

The use of the pictopolygraphic method supplemented the study of the patients' mental state by assessing the SES index of individual the HADS subscales (anxiety, depression) for each individual patient. Table 1 presents a comparative analysis of the HADS score (scores) and their correlation with the SES index in different groups of patients with TDD.

Patients of the 1st group obtained high values on the HADS scale indicating a pronounced level of anxiety (15.9 ± 2.3 points) and depression (16.4 ± 2.8 points). The reliability of the data was confirmed by the significance of the SES index ($p < 0.01$). There was also a pronounced relationship between indicators of anxiety, depression and the values of their SES indices ($ra = 0.76$, $p < 0.05$; $rd = 0.73$, $p < 0.05$).

In turn, 2nd and 3rd groups moderately expressed indicators of anxiety (12.6 ± 3.9 and 11.2 ± 2.8 points) and depression (13.8 ± 3.2 and 10.7 ± 4.9 points), significant differences between the groups were not detected. At the same time, in the 2nd group, the indicators of SES testified to the reliability of answers ($p < 0.05$), and in the third group, a low level of SES ($p > 0.05$) was noted. At the same time, in the 2nd group, a significant correlation between anxiety indicators and the SES index ($ra = 0.71$, $p < 0.05$) and moderate one between the indicators of depression and the SES index ($rd = 0.54$; $p < 0.05$) were found.

There were no correlations between the indicators of psychometric assessment and the significance of the SES indices ($p > 0.05$) in the 3rd group. Low indicators of free economic zones of the anxiety and depression subscale point to the absence of a significant "emotional response" in the process of answering the questions of these subscales. The data obtained indicated an exaggerated presentation of complaints by patients of the 3rd group, possibly due to the mechanism of "secondary benefit" (in general, the result of an insoluble psycho-traumatic personal or family situation).

The pictographic study was mentioned to determine the subjective significance of the asked questions (scales, questionnaires) for the subject calculated on the basis of indicators of individual physiological components recorded by the device (heart rate, PPG, EEG, etc.). The design feature

Table 1.

The HADS scale indicators (points) and their correlation with the semantic and emotional significance indices in different groups of TDRs

Табл. 1.

Показатели шкалы HADS (баллы) и их сопряженность со значимостью индексов СЭЗ в разных группах ТДР

Group No.	HADS Scale		Differences between groups (p<)	HADS/SES
	Anxiety (A)	Depression (D)		
1	15,9 ± 2,3	16,4 ± 2,8	A: 1/3 0,05 D: -	$r_a = 0,76$; $p< 0,05$ $r_d = 0,73$; $p< 0,05$
2	12,6 ± 3,9	13,8 ± 3,2	A: - D: -	$r_a = 0,71$; $p< 0,05$ $r_d = 0,54$; $p< 0,05$
3	11,2 ± 2,8	10,7 ± 4,9	A: - D: -	$r_a = 0,29$; $p> 0,05$ $r_d = 0,21$; $p> 0,05$

of the complex is the ability to select individual components during the calculation of the integral index of SES of asked questions.

The results of the study have shown that 28% of patients of the 3rd group reported significant manifestations of anxiety and depression (more than 11 points) with minimally significant levels of SES ($p < 0.05$). At the same time, a clinical and psychopathological study indicated an outwardly demonstrative, hyperbolic presentation of complaints by these patients. In this regard, in the course of further work, changes in individual physiological parameters of the greatest diagnostic value for patients with anxiety-depressive disorders were studied (Table 2).

The analysis of physiological parameters has shown that at the beginning of the study (before presenting questions on the HADS) HR indicators were (Fig. 1):
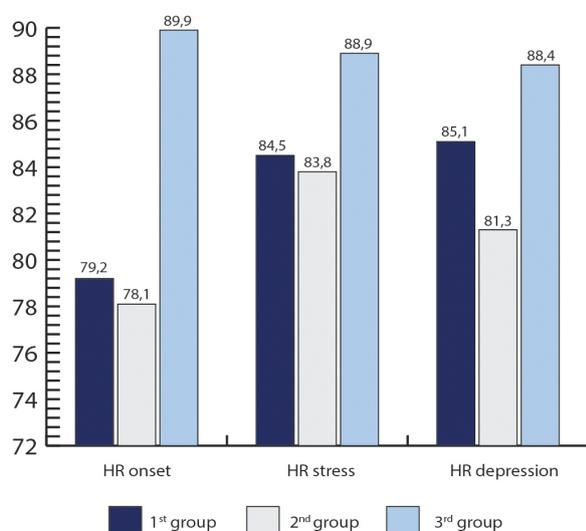

Fig. 1. HR indicators at the beginning of the study (background state) and when filling the HADS (bpm)
Рис. 1. Показатели ЧСС в начале исследования (фоновое состояние) и при заполнении шкалы HADS (уд/мин)

– in the 1st group – 79.5 ± 1.9 bpm;
– in the 2nd group –78.3 ± 1.5 bpm;
– in the 3rd group – 89.9 ± 5.9 bpm.

When answering the HADS questions regarding anxiety manifestations, heart rate indicators changed as follows:
– in the 1st group – 84.5 ± 1.9 bpm;
– in the 2nd group – 83.8 ± 1.5 bpm;
– in the 3rd group – 88.9 ± 5.9 bpm.

When answering questions related to depressive symptoms, heart rates were as follows:
– in the 1st group - 85.1 ± 1.2 bpm;
– in the 2nd group - 81.3 ± 2.8 bpm;
– in the 3rd group - 88.4 ± 5.3 bpm.

Thus, heart rate indicators in comparison with background parameters increased and had significant differences ($p <0.01$) in the first two groups. This testified to the subjective significance of the questions presented to patients:
– regarding anxiety and depression – in the 1st group;
– regarding anxiety – in the 2nd group.

HR dynamics did not have significant differences from the initial indicators in the 3rd group.

PPG indices at the beginning of the study (background state) were (Fig. 2):
- in the 1st group – 8.2 ± 2.2 units;
- in the 2nd group – 7.7 ± 1.9 units;
- in the 3rd group – 5.2 ± 1.0 units.

When answering the HADS questions regarding anxiety manifestations, the PPG indicator changed as follows:
– in the 1st group increased to 11.1 ± 1.9 units;
– in the 2nd and 3rd groups decreased to 5.7 ± 1.4 units. and 4.3 ± 0.7 units.

When answering questions related to depressive symptoms, the PPG indicator changed as follows:

Table 2.
Табл. 2.

Dynamics in changes of software and hardware complex Egoscope indicators before and after filling individual the HADS subscales

Динамика показателей ПАК «Эгоскоп» до и после заполнения отдельных подшкал HADS

Physiological parameter	Group No.	Background (B)	After HADS filling		p <
			Anxiety (a)	Depression(b)	
HR, bpm	1-я	79,2 ± 1,9	84,5 ± 1,9	85,1 ± 1,2	B/a 0,01; B/d 0,01
	2-я	78,1 ± 1,5	83,8 ± 1,5	81,3 ± 2,8	B/a 0,01
	3-я	89,9 ± 5,9	88,9 ± 5,9	88,4 ± 5,3	
PPG, units	1-я	8,2 ± 2,2	11,1 ± 1,9	11,4 ± 1,9	B/a 0,01; B/d 0,01
	2-я	7,7 ± 1,9	5,7 ± 1,4	6,1 ± 1,7	B/a 0,05; B/d 0,05
	3-я	5,2 ± 1,0	4,3 ± 0,7	4,7 ± 1,2	B/a 0,05
EEG, units	1-я	9,7 ± 0,5	12,6 ± 0,5	13,6 ± 0,5	B/a 0,01; B/d 0,01
	2-я	9,0 ± 0,5	13,0 ± 0,5	11,7 ± 0,7	B/a 0,01; B/d 0,01
	3-я	12,1 ± 0,6	18,6 ± 0,7	19,1 ± 0,6	B/a 0,01; B/d 0,01
GSR, units	1-я	108,5 ± 1,5	131,8 ± 1,5	128,8 ± 0,6	B/a 0,01; B/d 0,01
	2-я	95,8 ± 2,0	76,0 ± 2,5	66,4 ± 1,8	B/a 0,01; B/d 0,01
		139,7 ± 1,3	66,5 ± 1,3	39,4 ± 1,5	B/a 0,01; B/d 0,01

– in the 1st group increased to 11.4 ± 1.9 units, while these changes were significant (p < 0.01);

– in the 2nd and 3rd groups decreased to 6.1 ± 1.7 units. (p < 0.05) and 4.7 ± 1.2 units. (p > 0.05).

In general, the highest rates has been noted both at the beginning of the study (background state) and in the process of answering the questions of the HADS by patients of the 1st group illustrating the subjective significance of the statements associated with the phenomena of sympathicotonia. The dynamics of this indicator was negative in the 2nd and 3rd groups suggesting a less pronounced vegetative reaction to the questions asked.

The assessment of EEG was carried out on the basis of determining the dynamics of the integral EEG index - one of the main indicators of pictographic examination characterizing the activation processes of the cerebral cortex.

At the beginning of the study, it was found that (Fig. 3):
– in the 1st group, the EEG index was within 9.7 ± 0.5 units;
– in the 2nd group – 9.0 ± 0.5 units;
– in the 3rd group – 12.1 ± 0.5 units.

When answering the HADS questions regarding anxiety, the EEG index changed as follows:
– in the 1st group increased to 12.6 ± 0.5 units;
– in the 2nd group – up to 13.0 ± 0.5 units;
– to the 3rd group – up to 18.6 ± 0.7 units.

When answering questions related to depressive symptoms, the following changes were revealed:
– in the 1st group, the EEG index increased to 13.6 ± 0.5 units;
– in the 2nd group – up to 11.7 ± 0.7 units;
– in the 3rd group – up to 19.1 ± 0.6 units.

All changes in the indicators were statistically significant (p <0.01).

Particularly, the EEG indicator was approximately at the same level in all examined groups at the beginning of the study. During the study, the indicators increased significantly probably due to nonspecific activation of the cerebral cortex during the examination.

When analyzing the GSR index at the beginning of the study (Fig. 4):
– in the 1st group, this indicator was within 108.5 ± 1.5 units;
– in the 2nd group – 95.8 ± 2.0 units;
– in the 3rd group – 139.7 ± 1.3 units.

When filling in the HADS regarding manifestations of anxiety, the GSR index changed as follows:
– in the 1st group increased to 131.8 ± 1.5 units;
– in the 2nd and 3rd groups decreased to 76.0 ± 2.5 units and 66.5 ± 1.3 units.

When answering questions regarding depressive disorders, the GSR index was:
– in the 1st group increased to 128.8 ± 0.6 units;
– in the 2nd group decreased to 66.4 ± 1.8 units;
– in the 3rd group decreased to 39.4 ± 1.5 units.

All changes in the indicators were statistically significant (p < 0.01).

High GSR rates were noted both at the beginning of the study and during its conduct in patients of the 1st group ("endogenous" depression) indicating a tone (activity) of the sympathetic nervous system, increased sweating (increased anxiety) to individually significant questions. Changes in this indicator in individuals with neurotic disorders were negative.

Thus, the more emotionally significant were the questions asked during the study, the more pronounced was the deviation in the SES indicator for these questions. The patient's adjustive attitude to
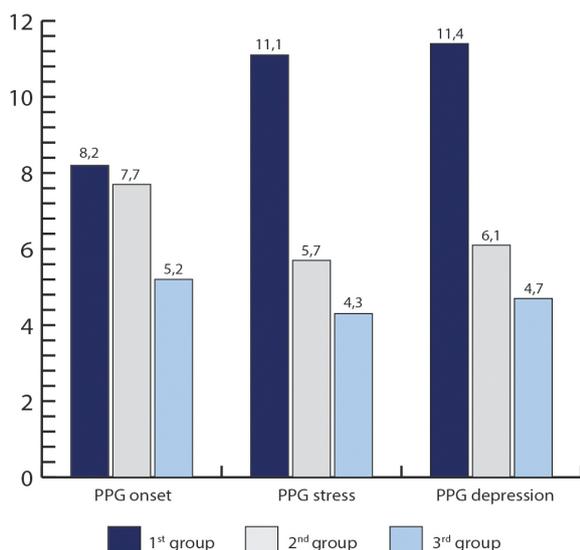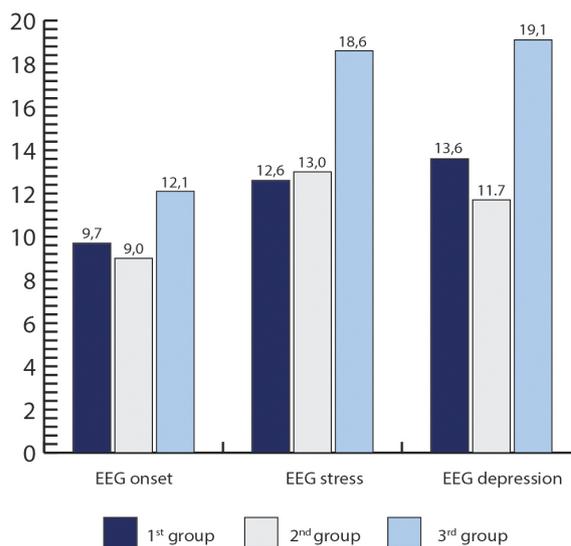

Fig. 2. PPG indicators at the beginning of the study (background state) and when filling the HADS (units)
Рис. 2. Показатели ФПГ в начале исследования (фоновое состояние) и при заполнении шкалы HADS (ед.)

Fig. 3. EEG indicators at the beginning of the study (background state) and when filling the HADS scale (units)
Рис. 3. Показатели ЭЭГ в начале исследования (фоновое состояние) и при заполнении шкалы HADS (ед.)

the examination and questions asked reflected in the increase in the variability of physiological parameters when filling in the scale. The increase in scatter was most likely manifested in cognitive dissonance – the condition characterized in the patient's mind by a clash of conflicting motives, beliefs, behavioral attitudes regarding the subjective assessment of his state, and the attitude to the examination being conducted.

On the whole, the study has shown that the largest difference in the pictopolygraphic examination of different study groups is manifested in the analysis of heart rate, and the dynamics of the PPG and RAG indicators in patients with neurotic disorders was, on the contrary, negative. The EEG changes are non-specific (most likely due to the general activation of the electrical activity of the cerebral cortex). This leads us to conclude that the heart rate indicator is the most "sensitive" in the participants with anxiety-depressive symptoms in the structure of a pictographic study and the additional personified assessment may increase the accuracy when a psychiatrist makes a final diagnostic report.

Fig. 4. GSR indicators at the beginning of the study (background state) and when filling the HADS (units)
Рис. 4. Показатели КП в начале исследования (фоновое состояние) и при заполнении шкалы HADS (ед.)

CONCLUSION

The results provide strong support for the hypothesis that the use of the clinical and psychopathological methods for assessing the condition of patients with affective disorders (especially in people with accentuations of the hysterically-excitable character type) is not sufficiently informative and does not always correspond to the real degree of expression of the existing affective violations (exaggerated and hyperbolic presentation of complaints). Excessive and insufficiently justified appointment of psychopharmacotherapy for such patients reduces the degree of their participation in psychotherapeutic study.

The use of the pictographic method in the examination of patients with anxiety-depressive disorders on a non-psychotic level may optimize the diagnostic process and improve the accuracy and quality of the diagnostic findings. It should be borne in mind that the indicator of heart rate has the greatest "sensitivity" in assessing the semantic and emotional significance.

This may contribute to a more accurate differential diagnosis, the choice of the most effective direction of psychotherapeutic work and, as a result, increase in the effectiveness of the treatment.

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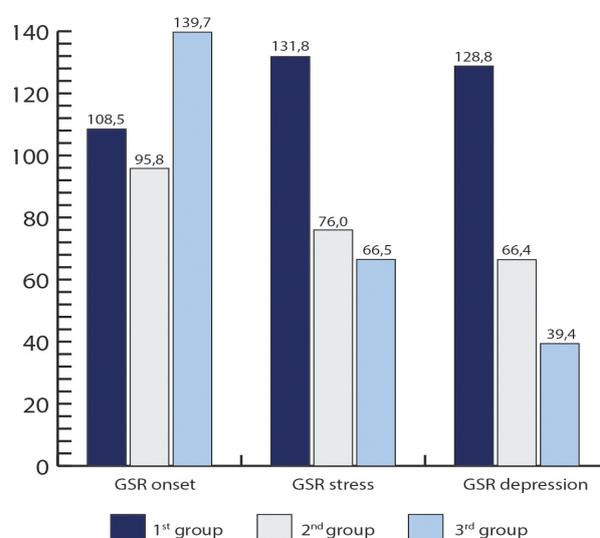8. Krasnov VN, Dovzhenko TV, Bobrov AE. Sovershenstvovanie metodov rannei diagnostiki psikhicheskikh rasstroistv (na

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Авторы заявляют, что у них нет конфликта интересов

Пиктополиграфический метод в диагностике расстройств адаптации

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В работе рассмотрен пиктополиграфический подход к объективизации аффективных нарушений непсихотического уровня. Обследованную выборку составили пациенты с тревожно-депрессивной симптоматикой (n=70). Основными методами исследования были клинико-психопатологический и пиктополиграфический (АПК «Эгоскоп»). Пиктополиграфический метод позволяет выполнять автоматизированное психометрическое обследование с применением стандартизированных опросников и шкал при одновременной регистрации ряда физиологических параметров: частоты сердечных сокращений (ЧСС), фотоплетизмограммы (ФПГ), электроэнцефалограммы (ЭЭГ), кожно-гальванической реакции (КГР) и пиктографических характеристик. Для оценки субъективного восприятия степени выраженности тревожных и депрессивных нарушений обследуемыми заполнялась Госпитальная шкала тревоги и депрессии (HADS). Установлено, что применение исключительно клинико-психопатологического метода для оценки состояния пациентов с аффективными нарушениями не является достаточно информативным и не всегда соответствует реальной степени выраженности имеющихся аффективных нарушений. Применение пиктополиграфического метода при обследовании пациентов с тревожно-депрессивными расстройствами непсихотического уровня позволяет оптимизировать диагностический процесс, повысить точность и качество выносимых диагностических заключений. Определены основные соотношения физиологических пиктополиграфических показателей с жалобами пациентов. Показано, что наиболее чувствительным и информативным компонентом изучаемого способа объективной оценки состояния пациентов с тревожно-депрессивными расстройствами является изменение частоты сердечных сокращений.

КЛЮЧЕВЫЕ СЛОВА: психиатрия; психологическая диагностика; аффективные нарушения; тревога; депрессия; пиктополиграфия; расстройства адаптации; военнослужащие; аффективные нарушения