

The Autonomic Nervous System and the Level of Stress in Schizophrenia

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Abstract – The autonomic nervous system of people with mental illness is influenced by the mode of pronounced predominance of sympathy. This mode mostly interferes with a patient's inability to participate in social events. Diagnostic interviews and questionnaires among the patients of the psychoneurological dispensary demonstrate that stressful situations brought no health-damaging impact. In turn, chronic psycho-emotional stress (usually induced by death of relatives, divorce, separation, loneliness, accidents injury, relocation) caused the first endogenous symptoms of mental illness. The stress index analysis of the psycho-neurological dispensary demonstrates the fact the chronic stress may cause a long-term mental illness.

Keywords – stress, the balance of the autonomic nervous system, regulatory system processes, schizophrenia.

I. INTRODUCTION

The modern medicine recognizes the importance of mental well-being for human. There is a significant amount of diverse research on the study of the etiology, pathophysiology, clinical perspective and dynamics of the mental illness development, including schizophrenia [1, 2]. According to the modern biopsychosocial approach of the mental illness development, chronic stress exposure triggers the onset of schizophrenia [10]. In turn, the long-term schizophrenia itself becomes one of the risk factors of psycho-emotional stress [3].

The stress impacts on the function of the body's main system, mostly – the endocrine, cardiovascular system, digestive, and other [4–7]. Thus, the stress affects on the endocrine and immune parameters, it causes the disturbance of homeostasis and its maintaining system, cause quantitative changes of humoral factors involved in the regulation of poststress conditions [4]. Stress affects factors that increase the heart disease, the risk of stroke, and provokes a heart rhythm disorder. [5]. Short-term and chronic stresses lead to qualitative and quantitative changes of the stomach and pancreas secretory functions [6] [7].

However, the domestic and foreign scientific research provides very little information about the stress impact on pathological disturbances of the higher nervous activity in the form of schizophrenia, the problem of patient vulnerability to various stressful events remains extremely debatable [8, 9].

The research objective is to study the interaction of the level of stress with the vegetative state and the duration of mental illness of the schizophrenic patients.

The main idea of the research is focused on:

- determination of the vegetative state of patients with mental illness (in terms of the Kerdo index);
- analysis of heart rate variability criteria (an indicator of regulatory system activity and psychological stress index (PSI) of schizophrenic patients;
- assessment of the premorbid stress role, the course and consequences of schizophrenic patients' mental state.

II. METHODS AND MATERIALS

40 patients suffering from paranoid schizophrenia (F20 – in accordance with the ICD classification, the bioethical norms and international GCP standards) of the Republican Psychoneurological Dispensary of Chechen Republic (chief physician – I.M. Mezhiyev) were examined. The average age of patients – 38.6 years. The duration of the disease – from 5 to 15 years (the onset of the first endogenous psychotic symptom was taken roughly as the onset of the disease). Sample structure by gender: 26 patients examined –men, 14 – women. Also 40 employees of Chechen State University were examined as a control group, with similar anthropometric parameters.

Diagnostic interviews and questionnaires were held for the analysis of the factors which had an impact on the mental illness development of the main group. The vegetative state of each surveyed was to be assessed with the help of the Kerdo index (KI) determined by the formula: $IC = (1 - HELL / HR) \times 100$. Blood pressure (BP) indicators were measured by the Korotkov method and heart rate (HR) by counting the arterial pulse values.

An indicator of the regulatory mechanisms' activity (SDNN) and psychological stress index (PSI) describe the activity of the central regulation and the level of stress in the body. These two indicators of heart rate variability were determined on the hardware and software complex 'Varicard – 2.6' by the Institute of Introduction of New Medical Technologies RAMENA Open Company. Statistical data analysis was obtained by the program 'Biostatistics 4.03'.

TABLE I. DIAGNOSTIC INTERVIEW AND QUESTIONNAIRE ANALYSIS

Illness duration in years	Number of patients	Plausible factors affecting the development of mental illness		
		Chronic stress	Genetic factors	Other causes
About 5 years	18	15	2	1
About 10 years	12	10	1	1
About 15 years	10	9	1	–
Total	40	34	4	2

TABLE II. THE VEGETATIVE HOMEOSTASIS CONDITION IN THE MAIN AND CONTROL GROUP

Vegetative homeostatic condition	The main group			Control group		
	Men	Women	Total	Men	Women	Total
Moderate predominance of the parasympathetic system: KI numbers below (-5)	2	1	3	2	4	6
Significant predominance of the parasympathetic system – KI numbers below (-10)	–	1	1	4	1	5
Balanced state of both sympathetical and parasympathetical systems KI numbers within (-10) to (+10)	1	1	2	12	8	20
Moderate predominance of the parasympathetic system: KI numbers above (-5)	8	4	12	5	4	9
Significant predominance of the sympathetic nervous system KI numbers are equal to (+10) or above	15	7	22	–	–	–
Total	26	14	40	23	17	40

III. RESULTS

According to the analysis of the case-record, the result of diagnostic interviews and questionnaires the patients were divided into three groups by the disease duration, and the possible causes of each were identified in Table 1.

The following factors were mentioned as the cause of chronic stress: conflicts in the family, at work, with neighbors, longitudinal care for severely ill patients, death of relatives, divorce, break-up, loneliness, accident injury, relocation, change of residence etc. The genetic factors were attributed according to the relatives affected by short or long-term mental illness. Other reasons: violent death threat or imprisonment. Table 1 shows that 86 % of patients’ mental illness development was influenced by various stressful situations and 11 % of patients had relatives with similar disorders; it confirms the hypotheses about the genetic factor influence [1].

In order to determine the type of vegetative regulation and the subsequent calculation of the Kerdo index (KI), patients of both groups had their blood pressure measured and the heart rate calculated. The mean values of blood pressure and heart rate in the group of patients with mental disorders were 137/80 mm Hg. and 82.5 in accordance. The result of the control group – 100/70 mm. Hg Art. and 70,2. This analysis according to the level of statistical probability indicates the predominance of sympathetic influences on the regulatory processes of the schizophrenic patients.

According to the analysis of KI values, Table 2 shows that only 5 % of the examined patients of the Psychoneurological dispensary experience a vegetative balance. 85 % of patients suffer from sympathicotonia, and 10 % of them suffer from vagotonia. The vegetative balance in the control group reaches in 50 % of all examined patients, vagotonia – in 27.5 %, and sympathicotonia – is observed in 22.5 % of university staff. The average Kerdo index in the main experimental group reaches 20.42 ± 2.95 , in the control group – 3.65 ± 2.19 . These numbers indicate a predominant sympathicotonia in the main experimental group and normotonia in the control group.

The next stage of research involved the patients’ examination using the software and hardware complex program ‘Varicard-2.6’ and the results were analyzed according to SDNN and SI.

The indicator of the regulatory mechanisms activity (SDNN) shows the regulatory system’s intensity followed by the non-specific reaction of the body to any adverse attack for it. This action has the following clinical interpretation in Table 3.

The study shows physiological system’s intensity of almost all the patients from the main group, and 85 % of patients suffer from the breakdown of the adaptation, which is followed by the body’s functional incapability. This can lead to the development of specific pathologic changes of the human organ system [1]. In the contrary, 82 and 18 percent of the examiners in the control group have a physiological norm and a prenological condition, and none of them suffer from

the breakdown of adaptation. The average value of SDNN in the main group is 8.01 ± 0.28 and in the control group – 3.37 ± 0.17 . Differences in the rates of SDNN in the main group in comparison to the control group were statistically significant

($p < 0.001$). In the main group, the indicators of SDNN were compared to the duration of the course of the disease. 52 % of patients with SDNN values from 8 to 10 had a disease duration of more than 7,5 years.

TABLE III. THE INDICATOR ANALYSIS OF REGULATORY SYSTEMS ACTIVITY OF THE PATIENTS

The values of SDNN	Clinical interpretation	The main group		Control group
		SDNN	Illness duration more than 7,5 years	
1–3	Physiological norms	–	–	32
4–5	Prenosological state	2	–	8
6–7	Premorbis state	4	1	–
8–10	Breakdown of adaptation	34	21	–
		Total number of people – 40	Total number of people – 22	Total number of people – 40

TABLE IV. ASSESSMENT OF STRESS IN THE MAIN AND CONTROL GROUP

Groups	SI indicators (conditional unit – cu.)	Degree of incidence (%)
Main group (subgroup 1)	15–150	5
Main group (subgroup 2)	150–500	32,5
Main group (subgroup 3)	500–1500	35
Main group (subgroup 4)	1500–15000	28.5
Control group (subgroup 1)	60–150	82
Control group (subgroup 2)	150–400	18

Clinical physicians describe the prenosological state life conditions followed by high intensity of the regulatory systems not normal. But sometimes the physiological changes may seem clinically normal condition and, therefore, doctors do not see any threat during dispensary and clinical examinations. This particularly applies to the mental illness diagnostics [2].

The stress index – SI (normally equal to 40–150 cu) reflects the central state of physiological function regulation, so it is very responsive to the tone of the sympathetic nervous system.

The number of examined people in the control group SI indicators reach 95 % this is a normal range (control subgroup 1) and 5 % (control 2 subgroup) – a slight increase of the indicator. Patients from the main group showed an intensity of the stress level so that they were divided into four subgroups. SI of the normal range was noted only in 4 % of patients in the main subgroup. The rest of the patients (96 %) had an intense stress index from 150 to 15,000 (Table 4)

The average SI values in the control group is 75.12 cu., and in the main group the number reaches 508.8 cu., it confirms the high level of mental illness and stress among the patients suffering from schizophrenia.

The comparative study analysis helps to determine possible relationship between the level of stress and the mental illness duration of each patient. In subgroup 1 (with SI from 15 to 150), the average duration of the disease is 6.8 years; in subgroup 2 (from SI from 150 to 500) – 7.5; in

subgroup 3 (from SI from 500 to 1500) – 8.8 and in subgroup 4 (from SI from 1500 to 15000) – 14.8 years.

IV. CONCLUSION

Results: The study analysis established the predominance of sympathetic influences on the body function regulations of people with mental illnesses, and the interaction of the stress level and schizophrenia duration.

Findings:

1. Long-term chronic stressful situations mostly become the cause and severe risk of mental illness development including schizophrenia.
2. SDNN and SI values are diagnostic markers to assess the severity of mental disorders.
3. Violations of GNI in the form of a diagnosed disease (paranoid form of schizophrenia) affect psycho-emotional stress and leads to the high-intensity of the body regulatory systems.
4. Gender factors have no influence on any of the research parameters.

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