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The Relationship Between Autonomic Dysfunction in Adolescent Girls and Menstrual Disorders Using the Example of a Comprehensive Examination

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Abstract The article presents the results of a comprehensive study of the relationship between autonomic dysfunction and menstrual disorders in adolescent girls. The relevance of the topic is due to the high prevalence of these pathologies in adolescence and the lack of knowledge of their pathogenetic mechanisms.

Keywords Autonomic dysfunction, Menstrual cycle, Adolescent girls, Neurovegetative regulation, Hormonal status

1. Introduction

For teenage girls, an important marker of health is considered to be the state of the formed menstrual cycle. [1,5,9,13]. In addition, an important component in the period of a dysregulatory shift is the structuring of the nervous system, especially the emotional response of the body, which, according to various authors [2,6,10,14], they vary from 50 to 80% of cases, the explanation of which lies in violations of vegetative function. Inadequate recovery of autonomic disorders leads to the chronization of the process, which is difficult to correct therapeutically at an older age, in addition, a so-called circle of interdependence is formed: a violation of the autonomic nervous system worsens the reproductive function of adolescent girls and vice versa, menstrual dysfunction provokes a violation of autonomic syndromes. However, the triggering pathomechanism is considered to be the imperfection of vegetative support at the stage of the origin of the regulatory centers of the autonomic nervous system: the hypothalamus-pituitary system, as a result of the body's adaptive mechanisms to upcoming changes and stresses [3,7,11]. Anatomical and functional features of the hypothalamus differ from other structural units by reactivity to all endogenous and exogenous factors [4,8,12]. In this regard, it seems necessary to conduct a study aimed at determining the factors and causes of clinical and functional changes in the vegetative status of adolescent girls with menstrual disorders.

The aim of the study is to study and substantiate the clinical and physiological features of autonomic dysfunction in adolescent girls with menstrual disorders.

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2. Research Materials and Methods

The study was conducted at the Multidisciplinary Clinic of Samarkand State Medical University (MC SamSMU), in the departments of pediatric neurology and gynecology; at the Multidisciplinary Children's Hospital in Samarkand, in the departments of pediatric neurology and pediatric gynecology. The study material consisted of teenage girls with an average age of 17.3±1 years, the main group consisted of 45; the inclusion criteria were signs of autonomic dysfunction and menstrual disorders. The control group consisted of teenage girls of the same age, 41 healthy. The study was conducted in several stages, selecting patients from among those who applied for inpatient treatment; clinical and neurological examination, examination by a pediatrician, dentist, ENT doctor. Instrumental research methods: ultrasound of the pelvic organs, ultrasound of brachiocephalic vessels, ECG, EEG; Neuroimaging of the brain (MRI), with a Turkish saddle sight; laboratory research methods: standard analysis of blood biochemistry; hormones: progesterone, estradiol, testosterone, cortisol, leptin. Non-psychological testing based on the Spielberg-Khanin questionnaire. Statistical processing of research results on an individual computer, using standard software packages of Student criteria.

3. Result of Investigation

As noted, the main group of adolescent girls was 45, with an average age of 17.2±1 years, the average age of the first menstrual cycles (menarche) was 15±0.4 years. Menstrual

cycle disorders (MSCs) were observed from 2 to 6 months, and the period of menstruation itself was on average 9 ± 1 day, with scant discharge. At the initial examination, the initial and main complaint of all teenage girls was headache, of a different nature in terms of pain intensity, duration and range. Most often, cephalgias were stolen and intensified with fatigue (mental or physical overload). In the second place, according to the regularity of complaints, there were signs of emotional lability, more often tearfulness, or aggressiveness. Another common complaint was poor sleep, while daytime sleepiness disrupted the rhythm of daytime activity. Since the purpose of the study was to analyze the results of monitoring the autonomic nervous system, all patients underwent dynamic monitoring of blood pressure and heart rate. Blood pressure indicators showed different changes in height, as well as heart rate variability, in contrast to the group of healthy adolescent girls (control group 41). Distinctive signs were revealed in the main group, during an objective examination of the patients, so 26 teenage girls had symptoms of vagotonia, and the remaining 19 patients showed signs of sympathicotonic disorders. In this regard, it was logical to divide the patients into subgroups, 26 patients with vagotonia were included in 1 subgroup, and accordingly, 19 patients made up the 2nd subgroup. The blood pressure value for 1 subgroup (1P) was low compared to the healthy group (from 100/60 and below); the heart rate was within 70 beats per minute. In the traditional study of patients with autonomic dysfunction, the integral value of the Kerdo vegetative index is used, which in this subgroup was in the range of 5.20± 0.10 and was considered a negative indicator, at the same time, the integral value of blood circulation - minute volume was detected on average 2035.7±50 mils. The result of the examination of patients in the 2nd subgroup (2P) revealed elevated blood pressure (from 130/80 and above), while the heart rate had a range of 83 (85) beats per minute. The integral value of the Kerdo index averaged 7.58±0.2, that is, a positive value, and the integral value of the minute volume of blood circulation was 4900.90±58.1 mils. The standard diagnostic examination includes the exclusion and differentiation of comorbid diseases. In this regard, the teenage girls underwent additional examinations: pediatrician, dentist, ENT; ultrasound of internal organs, spirometry, ECG. During this examination, some kind of changes were revealed in each subgroup, so in 1P (with a predominance of vagotonia), complaints related to the gastrointestinal tract (poor appetite, nausea, rumbling, frequent diarrhea) were more often noted; on the part of ENT pathology, allergic rhinitis and ear soreness were also more often noted. Whereas the 2nd subgroup of teenage girls suffered from excess weight. The control of the Kerdo index in dynamics, in 1P, was defined as a negative value, where the minute volume in the correlation ratio indicates a parasympathetic effect on the vascular system, and vice versa, the advantage of sympathicotonic pressure in 2P. As a result of these processes, cardiac abnormalities were more often noted in the second subgroup, and the relationship between the cardiovascular and respiratory systems (normally 3-5) was on average 2.5-2.8 in 1P, and 4.9-5.1 in 2P. All this is reflected in the ECG parameters, in the form of idiosyncratic idiosyncratic elements in the leads. At the same time, in 1P (vagotonia), the second lead had an average of 48 units; and teenage girls in 2P (sympathonia), the lead showed an average of 162 units.units. Thus, combining the parameters of the initial examination, in the main group of adolescent girls, autonomic dysfunction was diagnosed in two dimensions: vagotonic and sympathotonic types.

The specifics of the bioelectric activity of the brain are presented as a result of the analysis of the EEG in adolescent girls in the dynamics of development. There were also common and distinctive features between the subgroups. In 1P, the focus of functioning was characterized by the uncertainty of brain structures, where in most cases the alifa range is marked with pointed peaks with an average frequency of 12 HZ and an average amplitude of 55 mv. The same parameters occurred in 2P, but in smaller numbers. On average, 30% of cases in each subgroup were found to be common to both subgroups, slow or sharp waves, or synchronization in the alifa/gamma zones of the bilateral or frontal lobes. Thus, the EEG research method confirms the presence of dissociation of the hypotolamo-cortical structures of the nervous system, due to increased bioelectric activity of the brain and cerebral dysfunctions.

MRI of the brain was performed at the inpatient stage of the examination using a standard 1.5 T tomograph (General Electronics, USA) (2018), and neuroimaging of the brain was performed on all adolescent girls with an eye to the area of the Turkish saddle (chiasmal capillary). The result of the study showed the following values: in the main group of adolescent girls, 3.6% of cases showed scattered, indistinct changes in the pituitary gland; in 2.1%, signs of the so-called "empty Turkish saddle"; in 19.5% of cases, a microadenoma (less than 10 mm) was detected; and in 1 case, a benign neoplasm (Ratke's cyst), the total number of abnormalities detected on MRI was 25.2%, in other cases, no structural changes were recorded. Thus, combining the parameters of the initial examination, in the main group of adolescent girls, autonomic dysfunction was diagnosed in two dimensions: vagotonic and sympathotonic types.

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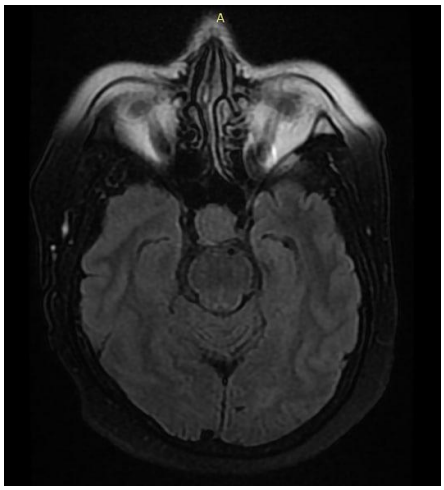

Figure 1. MRI – signs of cystic formation in the sellar region. Cystic adenoma of the pituitary gland. An empty Turkish saddle. Vascular encephalopathy. Indirect signs of intracranial hypertension. Subatrophic processes of the cerebral hemispheres

The serum level of leptin was determined in all the examined adolescents. It is known that hormones are involved in the mechanism of the reproductive system, but leptin plays the main role in the metabolism and regulation of other gonadotropic hormones and in a woman's body it proportionally depends on the mass of adipose tissue. Thyroid hormones inhibit lipogenesis and disrupt the maturation of reproductive function, in addition, they are involved in the development of neuroendocrine diseases. Thus, when examining the level of leptin in the blood serum of the examined adolescent girls, there was a significant decrease in the 1st group (adolescent girls with a lower body weight), which was statistically different from the 2nd group, where $P<0.05$, and the difference with the control group, where $P<0.01$.

The indicator of the degree of leptin in the blood differed from the control group (in adolescent girls with normal body weight), and averaged 12.01 ng/ ml, while in 1P the indicator had a low level of 3.3 ng/ml on average, and in 2P it was higher than normal, with an average of 16.04 ng/ml of changes. Analysis of the results of laboratory parameters of leptin in adolescent girls, in a comprehensive examination with other indicators, confirms the commonality and collaboration with other hormones in the pathomechanism of menstrual dysfunction.

The characteristic of the examined teenage girls, in addition to vegetative changes, was the fact of menstrual cycle disorders, so it was logical to study the issue of hormonal background, the main ones: estradiol, testosterone and progesterone, cortisol. The difficulty in determining the results of the analysis was the absence of a menstrual cycle, since according to the standard it is necessary to fix the hormonal assessment with the level of the menstrual cycle phase. In this regard, based on the initial onset of menarchies, the period of the menstrual cycle was conditionally determined, thus the division of the cycle phase was also conditional. In addition, hormone levels were evaluated with the results of a group of healthy teenage girls for comparison. The indicators of hormonal changes were as follows: in both subgroups, estradiol and testosterone were higher than the norm; progesterone in both subgroups was lower than normal; cortisol exceeded the norm, and by much higher, naturally, the intensity of cortisol is aimed at increasing stress, which reduces the effectiveness of adaptation in the body, and as a result increases the anxiety-depressive process and It is the root cause of menstrual rhythm disorders.

Table 1. The result of the analysis of steroid hormones in adolescent girls of the main and control groups

Indicators	Progesterone (nmol/L)	Estradiol (pmol/l)	Testosterone (nmol/L)	Cortisol (nmol/L)
The main group (n=45)				
1 subgroup (n = 26) of US 1F US 2F	3±1,0 9±2,0	400±25 520±36	1,2±0,5 1,3±0,5	410±45 470±49
2 subgroups (n = 19) of US 1F US 2	2,5±1,0 9,5±2,9	400±34 550±43	1,8±0,5 1,7±0,5	409±41 480±55
The control group (n=41) was 1F US 2F	3±0,1 22±5	230±50 380±34	1,5±0,5 1,5±0,5	290±42 300±20

Therefore, it was appropriate to conduct, as a subsequent stage, an assessment of the psychoemotional state of adolescent girls using the traditional (accessible) Spielberger-Khanin questionnaire to determine the level of anxiety and depression. The result of the analysis of the Spielberger-Khanin questionnaire demonstrated high levels of personal and situational anxiety, in addition, an increased result of emotional lability in both subgroups. At the same time, the correlation analysis between these indicators was directly proportional and depends on the heart rate. In comparison between the data of clinical laboratory, instrumental research methods and psychoemotional analyses, the predominance of emotionally disturbing personality characteristic disorders directly affecting the cardiovascular system was noted.

Table 2. The result of testing according to the Spielberger-Khanin questionnaire in the surveyed main group

indicators	Situational anxiety	Personal anxiety
1st group (n=26)	50±1,7	50±1,0
2nd group (n=19)	51±1,6	49±1,5

4. Conclusions

Thus, the data obtained show that adolescent girls with disorders of vegetative balance and menstrual cycle have high rates of psychoemotional state, while the predominance of sympatho-adrenal reactions is an indicator of severe stress. The analysis of a comprehensive examination (clinical, laboratory, instrumental, neuroimaging and neuropsychiatric studies) in adolescent girls with menstrual rhythm disorders and autonomic dysfunction explains and confirms the systemic functioning that forms the pathomechanism of changes in the central and autonomic nervous systems and major body systems. Such a comprehensive integrative approach to the examination of adolescent girls with menstrual disorders and autonomic dysfunction is important for predicting the course of the disease and determining tactics and correction of therapeutic and rehabilitative measures.

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