

BIOELECTRIC ACTIVITY OF CEREBRAL CORTEX IN PATIENTS WITH CYCLES OF ASSISTED REPRODUCTIVE TECHNOLOGIES

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Abstract

The mental state of patients and, to a greater extent, their psychological and psychoemotional features, have a great influence on fertility and, accordingly, on the result of infertility treatment by assisted reproductive technologies (ART). The aim of the study was to assess the bioelectrical activity of the cerebral cortex on the day of ovulation and the implantation window in the simulation of emotional stress in healthy women and patients in cycles of ART. A total of 64 reproductively healthy fertile patients and 43 female ovulating women with tubal peritoneal infertility were examined and applied for treatment in ART. The recording of the electroencephalogram (EEG) was performed in accordance with the "10-20" system in the frontal, central, occipital, temporal regions on the right and left. The characteristics of the bioelectric activity of the cerebral cortex in groups of women with tubal peritoneal infertility, planning the passage of ART cycles, and stress-unstable fertile women are similar, which is manifested by the absence of differences in the parameters of the dominant and average frequency of the rhythm, the maximum and average amplitude on the 5th-6th day of the menstrual period cycle, the day of ovulation, as well as the growth of dominant activity during the period of the implantation window. The decay of the regular alpha-rhythm, when replaced with a faster beta-activity, combined with a significant increase in vegetative reactivity (especially with respect to the low-frequency component of the

spectrum), confirmed during the implantation window, confirms the hypothesis of a particular stressful vulnerability of the 21th-22th day of the menstrual cycle, which is fundamentally important for the successful implantation of blastocyst.

Key words: infertility, bioelectrical activity of the cerebral cortex, electroencephalogram, alpha-rhythm.

According to WHO, the problem of infertility is in modern society in the conditions of depopulation of one of the most urgent medical, social and psychological demographic problems, which is caused by a combination of social, mental ill-being and, almost always, physical ill health and psychological stress in the family [7, 9].

One of the most promising methods of infertility treatment is the method of assisted reproductive technologies (ART). Currently, the ART results in 40% on 1 transfer of the embryo to the uterine cavity, and the number of children born as a result of this method is already estimated in millions [1].

The mental state of patients and, to a greater extent, their psychological and psychoemotional features, have a great influence on fertility and, accordingly, on the result of infertility treatment by ART. In this regard, the problem of psychoemotional reactions in women with infertility is becoming increasingly important due to both the widespread prevalence of these disorders in the population and the insufficient study of the influence of mental health on the human reproductive system, which significantly increases the relative risk of infertility development [4, 12].

The development of psychoemotional reactions occurs with a complex interaction of biological, social, psychological factors leading to a holistic response of the organism to a complex effect. Therefore, research in the field of psychological manifestations is being rapidly developed at the junction of biology, medicine, ecology, sociology and psychology.

Objectively, stress is manifested by the excitation of the autonomic centers of the central nervous system with activation of the hypothalamic-pituitary-adrenal system, increased concentrations of catecholamines and glucocorticoids in the blood, aimed at preserving the body's homeostasis [11]. Under stressful actions, the body responds systemically, while the immune, nervous and endocrine systems interact [3].

The overwhelming majority (79.4%) of women with infertility have different psychoemotional disorders, which are mainly presented as anxious, anxious-depressive and depressive reactions. The frequency and severity of psychoemotional reactions in infertile women are directly dependent on the duration of infertility treatment, its pathogenetic forms

and the social status of women. As the duration of infertility treatment increases (more than 5 years), there is a decrease in the frequency of anxiety reactions and the transformation of symptoms due to its deepening and attachment of the depressive component [2].

A number of studies have shown that, in women undergoing treatment in ART cycles, neurotic disorders, comorbidity of anxiety and depression are prevalent on the average with prevalence of disturbances of a disturbing spectrum of a psychogenic nature [1, 8].

Psychological factors can contribute to the etiology of infertility and influence the outcome of treatment [9, 10, 14]. In studies, the role of factors such as stress, emotional experiences, subconscious conflicts, conflict childhood, family relationships, fear of pregnancy and maternity, fear of childbirth and postnatal psychosis, the contradiction between the desire for professional activity and maternity, conflicts in the workplace, obsessive the desire to have a child [9, 10, 14].

The primary trauma from childlessness (the personal tragedy of the inability to be a mother or father, to feel the joy of pregnancy and parenthood) can be supplemented by a secondary trauma - from lack of support from the spouse, or the violation of family relationships on the basis of childlessness. Strong experiences can upset the work of the reproductive system until its complete "stop" [7, 13].

The diagnosis of infertility in terms of stress can be compared with such severe psychological trauma as loss of a family member, incurable disease, divorce, etc. ; a childless couple experiences strong emotional reactions such as grief / depression, frustration, shame, embarrassment, guilt, sadness, anxiety [10]. The severity of the experience can cause a decrease in self-esteem, self-esteem, changes in marital relations and satisfaction with marriage, changes in the sexual sphere, pregnancy expectation syndrome. In turn, these conditions can affect the reproductive capacity. A number of studies have shown that infertility can lead to a disruption of interpersonal relationships, a sense of instability in the marital status. Thus, repeated marriages in families with infertility were 5 times more frequent than in fertile couples (17.9% and 3.3%, respectively) [13].

In the treatment of infertility, a number of psychological disorders are often observed: phobias, obsessive thoughts, hysterical symptoms and even in rare cases - schizoid symptoms. The very process of treatment, for example, attempts at fertilization, causes a feeling of constant monthly anxiety in a woman and can enhance or cause an awareness of one's own childlessness, social inferiority, which in itself is a powerful stress [5]. Women can form a negative image of "I" and develop a sense of inferiority, because motherhood is perceived by them as a necessary element of self-realization and fulfillment of their social role. Despite a

large number of attempts, the largest percentage of women abandon the ART program after the fourth unsuccessful attempt. The reasons for the cessation of treatment are financial problems, the perception of ART as a stressful situation, worsening of health, exacerbation of somatic diseases, psychosomatic complaints, family problems.

Electroencephalography is a method that consists in recording and analyzing the total bioelectrical activity of the brain - the electroencephalogram (EEG). He is one of the classical methods of psychophysiological research. In the literature, there are single reports on the study of brain bioelectric activity in patients with infertility with EEG.

The aim of the study was to assess the bioelectrical activity of the cerebral cortex on the day of ovulation and the implantation window in the simulation of emotional stress in healthy women and patients in cycles of assisted reproductive technologies.

Material and methods

A total of 64 reproductively healthy fertile patients (Group I) and 43 female ovulating women with tubal peritoneal infertility (Group II), which applied for treatment in ART, were examined.

Groups of women were homogeneous by age, anthropometric data, social status, characteristics of menstrual function, somatic diseases, infectious anamnesis.

The recording of the electroencephalogram (EEG) was performed in accordance with the "10-20" system in the frontal, central, occipital, temporal regions on the right and left using the Neuron Spectrum electroencephalograph.

The dynamics of the functional state of the central nervous system with an estimate of the bioelectrical activity of the cerebral cortex in the modeling of emotional stress in healthy women of reproductive age was studied. The dominant EEG rhythm was studied on the 5th-6th day of the menstrual cycle, on the day of ovulation and on the day of the intended implantation window. In group I two subgroups are distinguished: subgroup ISU - 33 stress-unstable patients and subgroup ISR - 31 stress-resistant woman. Comparison of the dominant rhythm of EEG in reproductively healthy women and patients of ART cycles was carried out.

Statistical processing of the material was carried out using variational, correlation and graphic analysis methods using Student, Fisher, χ^2 -square, Mann-Whitney, Wilcoxon and McNemara criteria, standard and specialized computer programs. The mean (M), standard deviation error (SE) was determined.

Results and discussion

Analysis of electroencephalograms in the dynamics of the menstrual cycle in Group I patients showed fluctuations in the frequency and amplitude of the dominant rhythm in both

the stress-resistant group and in the group of stress-unresistant fertile women. They reached average values on the 5th-6th day of the menstrual cycle, were the smallest on the day of ovulation and reached a peak on the day of the expected window of implantation (Table).

Table

Dynamics of the parameters of the dominant rhythm of the electroencephalogram in stress-resistant groups and stress-unstable fertile women in different periods of the menstrual cycle (M ± SE)

EEG parameters		5-6th day of the menstrual cycle		Ovulation Day		Day of expected implantation window	
		O1	O2	O1	O2	O1	O2
Average frequency, Hz	ISR	10.2±0.05	10.0±0.10	9.8±0.04	9.7±0.03*	10.1±0.09*	10.3±0.12*
	ISU	10.1±0.09	10.1±0.18	9.9±0.04	9.9±0.03*	10.5±0.05*	10.6±0.08*
Average amplitude, μV	ISR	22.8±1.10*	21.2±3.15	21.7±1.34*	20.8±0.32*	30.2±2.02*	28.5±1.14*
	ISU	19.9±0.64*	20.1±2.13	17.5±1.15*	17.9±0.68*	24.9±1.51*	25.1±1.14*

Notes. 1. O1 - left occipital lead; O2 - right occipital lead; 2. * - statistically significant differences between the ISR and ISU subgroups (p<0,05).

According to the results obtained, a pronounced tendency of the main EEG alpha-rhythm indices in the occipital leads in the group of stress-unstable women to beta activity was revealed (the maximum amplitude in the stress-unstable group was higher by 68% on the left and 46% on the right, the dominant frequency was less than 10 Hz, p < 0.05). A similar tendency was traced throughout the menstrual cycle, with an emphasis on the expected day of the implantation window.

As follows from the data obtained, the parameters of the ART group had a dynamics similar to that of stress-unstable healthy women during the entire menstrual cycle (Fig.). Thus, the highest values of the frequency and amplitude of the dominant rhythm were also reliably observed during the period of the implantation window. At the same time, not only a significant increase in vegetative reactivity occurred during the expected day of the implantation window, but also the breakdown of the regular alpha rhythm with replacement by its faster beta activity occurred. This confirms the hypothesis of a particular stressful vulnerability of the 21th-22th day of the menstrual cycle, optimal for successful expected day blastocyst implantation.

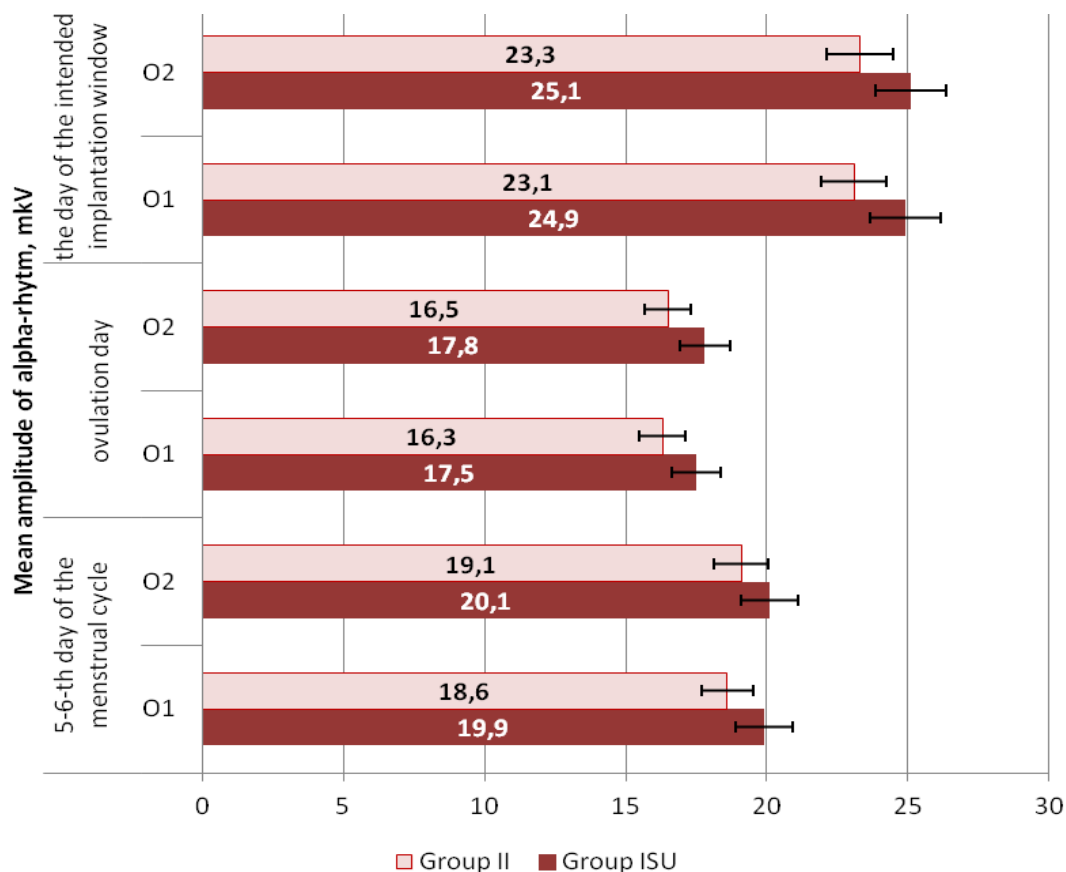


Figure Comparison of the mean amplitude of the dominant EEG rhythm in the group of stress-unstable fertile women (ISU, n = 31) and the group of infertile patients of ART (II, n = 43) cycles. Note: O1 - left occipital lead; O2 - right occipital lead.

As can be seen from the figure above, the parameters of the average amplitude of the dominant EEG rhythm of patients with ART-cycles with tubal peritoneal infertility were similar to those of stress-unstable fertile women on the day of ovulation and the implantation window.

Conclusions

The characteristics of the bioelectric activity of the cerebral cortex in groups of women with tubal peritoneal infertility, planning the passage of ART cycles, and stress-unstable fertile women are similar, which is manifested by the absence of differences in the parameters of the dominant and average frequency of the rhythm, the maximum and average amplitude on the 5th-6th day of the menstrual period cycle, the day of ovulation, as well as the growth of dominant activity during the period of the implantation window. The decay of the regular alpha-rhythm, when replaced with a faster beta-activity, combined with a significant increase in vegetative reactivity (especially with respect to the low-frequency

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