Development of a method for differential diagnosis of schizophrenia and depression using the method of Cognitive Visual Evoked Potentials

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***Abstract*— The features of functional disorders of the visual system described in the literature in patients with schizophrenia and depression are contradictory. Therefore, there are no unified ideas about the physiological mechanisms underlying these mental disorders. Therefore, there are no unified ideas about the physiological mechanisms underlying these mental disorders. The results obtained using the wavelet analyses of cognitive visual evoked potentials made it possible to make an assumption about the dependence of the amplitude characteristics of the early and late components of evoked potentials on the nature of mental disorders - affective (depression) or process (schizophrenia). Data were obtained that in patients with depression, predominantly early stages of processing visual information were impaired, and in patients with schizophrenia, both early and late stages. It has been shown, that in patients of both groups with disease duration of 1 year to 7 years, visual processing disorders are observed mainly by the parvocellular system.**

***Index Terms*—cognitive visual evoked potentials, depression, parvocellular and magnocellular systems, schizophrenia, wavelet filtration of images**

I. Introduction

In recent years, increasing attention is paid to study of the neurophysiological mechanisms underlying cognitive impairment in patients with schizophrenia and depression. For these patients, characteristic features are disturbances in the processing of visual information, which plays a key role for human adaptation in the environment [1, 2, 3, 4]. In the basis of violations lies primarily a dysfunction of the system of "object vision": i.e., the contours of objects, letters and colors are perceived blurry, characterized by rapid color fatigue. This dysfunction of the system of "object vision" can later be joined by violations of "spatial vision": i.e., complaints of spatial violations and impaired perception of black and white images [5].

To assess cognitive impairment in patients with neuropsychiatric pathology, the method of cognitive visual evoked potentials has long been used. On the basis of this method, a more subtle research method was developed and tested in the clinic - with the perception of images of objects processed by the wavelet method, for the selective assessment of the system of "object" (parvocellular system) or "spatial" (magnocellular system) vision. The parvocellular system provides detailed analysis of the fragments found with high resolution and is sensitive to high spatial frequencies and high contrasts. Its function is to analyze color (mainly red, yellow and green colors), texture, and recognition of small objects and their details ("object vision") [6]. The magnocellular system is sensitive to low spatial frequencies and low contrasts and is able to respond quickly to temporal changes in the image. Its function is to analyze black and white images, dynamic changes in the image, localization of objects of interest and processing of information necessary for orientation in space ("spatial vision") [6].

II. Methods

The purpose of the work is to study visual processing disorders in patients with schizophrenia and depression with a disease duration of 1 year to 7 years. The study involved 40 patients with procedural disorders and 20 patients with affective disorders aged 21 to 40 years. The control group consisted of 30 healthy subjects aged 18 to 35 years. In all observers, visual acuity was at least 0.9 or corrected to 0.9, and refraction was normal. The study used the analysis of the amplitude of the components of the cognitive visual evoked potentials when demonstrating images. Stimuli were represented by grayscale monochrome outline images. One half of which contained the low-frequency part of the spatial frequency spectrum (for the selective activation of magnocellular system), the other half - the high-frequency part (for the selective activation of parvocellular system). To isolate high spatial frequencies, a filter was used with a maximum transmittance at a frequency of 10 cycles/deg; and low frequencies, 1 cycle/deg. Filtration was performed by convolution of images with the DoG- function (abbr. from Difference of Gaussians), a wavelet representing the difference of two two-dimensional Gauss functions with different half-widths.

III. Results

As a result of the amplitude of the components of cognitive visual evoked potentials, it was shown that in patients of both groups there is a violation of information processing mainly by the parvocellular system responsible for "object vision". For patients with depression, the most pronounced amplitude changes were obtained for the P100 (N100) and P170 (N170) components (early components VEP), single ones - for P250 (N250) and no changes - for P350-P500 (late components)- disturbances are observed in the early stages of visual information processing (primary perception, primary differentiation). For patients with schizophrenia, the most pronounced changes in amplitude were obtained for the components P100 (N100), N170, P250 (N250), and P350-500 (early and late components VEP) - both early and late stages of visual information processing (decision making, deep processing of information, translation into short-term working memory) were impaired.

Accordingly, application of this method can be the basis for diagnostic methods of cognitive disorders in patients with neuropsychiatric pathology.

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