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## METHOD OF DIAGNOSTICS OF ELECTRIC INFRINGEMENTS OF MYOCARDIUM

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**Keywords:** myocardium, anthracycline antibiotics, electrocardiogram, doxorubicin, cytostatics.

**Abstract.** The method for diagnosing disorders of myocardial electrical activity is as follows: ECG and its first derivative are recorded in twelve generally accepted leads for patients with breast cancer. Moreover, with the introduction of a doxorubicin exchange dose, the ventricular activation rate is calculated as the ratio of the maximum amplitude of the differentiated curve of the QRS complex to the maximum amplitude of the QRS complex of a normal ECG. An arithmetic mean value is found for each subject and the activation rate of the ventricles of the heart is 42.3 and below is considered as a critical value for the diagnosis of impaired electrical activity of the myocardium. The method allows to detect early violations of the electrical activity of the heart in patients with breast cancer during treatment with cardiotoxic doxorubicin.

## МЕТОД ДИАГНОСТИКИ НАРУШЕНИЙ ЭЛЕКТРИЧЕСКОЙ АКТИВНОСТИ МИОКАРДА

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**Ключевые слова:** миокард, антрациклиновые антибиотики, электрокардиограмма, доксорубин, цитостатики.

**Аннотация.** Метод диагностики нарушений электрической активности миокарда заключается в следующем: больным раком молочной железы регистрируют ЭКГ и ее первую производную в двенадцати общепринятых отведениях. При этом при введении курсовой дозы доксорубина вычисляют скорость активации желудочков как отношение максимальной амплитуды дифференцированной кривой комплекса QRS к максимальной амплитуде комплекса QRS обычной ЭКГ. Находят среднее арифметическое значение для каждого обследуемого и скорость активации желудочков сердца  $42,3 \text{ с}^{-1}$  и ниже рассматривают как критическое значение для диагностики нарушений электрической активности миокарда. Метод позволяет выявить ранние нарушения электрической активности сердца у больных раком молочной железы при лечении кардиотоксичным доксорубином.

The method relates to medicine, in particular to clinical cardiology, and can be used for the early diagnosis of impaired electrical activity and myocardial functional state. Due to significant advances in the treatment of malignant tumors, the number of cured significantly increases. At the same time, with an increase in the number of cured and follow-up periods, they began to detect side effects of antitumor treatment, among which cardiomyopathies due to the use of anthracycline antitumor antibiotics are prominent. Changes in the myocardium at first can occur without clinical manifestations, not be detected by conventional methods of study and only after a time manifest violations of the contractile function of the myocardium and cardiomyopathies with severe heart failure, ending, as a rule, fatally no less than half of patients. In this regard, the prophylactic direction is recognized as conceptual in the process of preventing cardiac complications in cancer patients during treatment. A timely problem of cardiology remains the timely prediction of myocardial electrical activity disorders. A fundamental method for assessing the electrical activity of the heart in clinical practice is the ECG.

The objective of the method is the diagnosis of myocardial electrical activity disorders in patients with breast cancer during treatment with doxorubicin. This technical result is realized due to the fact that in a known method for diagnosing impaired electrical activity of the myocardium during normal ECG by registering an ECG and its first derivative in 12 generally accepted leads, according to the invention, patients with breast cancer will calculate the ventricular activation as the ratio of the maximum amplitude of the differentiated curve of the QRS complex to the maximum amplitude of the QRS complex of a conventional ECG; find the arithmetic average value for each subject and the activation rate of the ventricles of the heart 42.3 and below is considered as a critical value for the diagnosis of disorders of the electrical activity of the myocardium. Studies on patent and scientific and technical information sources showed that the proposed method is unknown in cardiology and meets the criteria of "novelty" and "inventive step". The described method can be applied in oncological clinics equipped with standard equipment, is easily accessible, highly sensitive, non-invasive and, therefore, "practically applicable". The method is as follows. The patient is placed in a horizontal position and the ECG and its first derivative are removed in 12 standard leads using any electrocardiograph and electronic set-top box with a time constant of 0075, which is based on the analog-to-digital conversion method of the ECG circuit. The magnitude of the ventricular activation rate is defined as the ratio of the maximum amplitude of the differentiated curve of the QRS complex to the maximum amplitude of the QRS complex of a normal ECG. The value of the rate of activation of the ventricles in each of the 12 leads with the average arithmetic for each subject is calculated and at a rate of activation of the ventricles of the heart  $42.3 \pm 0.4 \text{ s}^{-1}$  and below, a violation of the electrical activity of the myocardium is diagnosed. A study was conducted that included 53 women with breast cancer. All studied were treated with doxorubicin. One of the criteria for inclusion in this group was the absence of pathological changes on the ECG. The study of high-speed activation of the ventricles was carried out before the start of treatment, after administration of doxorubicin in a dose of  $146.7 \text{ mg} / \text{m}^2$  and  $274.54 \text{ mg} / \text{m}^2$ .

According to the results of the study, after the administration of doxorubicin in the dose of  $274.54 \text{ mg} / \text{m}^2$  to the patients, the ventricular activation rate was  $42.3 \pm 0.4 \text{ s}^{-1}$ , which was significantly lower than the same value before treatment.

The results indicate that patients with breast cancer after administration of doxorubicin at a dose of  $274.54 \text{ mg} / \text{m}^2$  have a decrease in the rate of ventricular activation, which is of significant pathophysiological importance in explaining the mechanism of development of electrical myocardial instability. The main histological features of the acute cardiotoxic effect of anthracyclines are myocardial cell degeneration of myocardial cells, vacuolization of the cytoplasm and destruction of cell membranes. Anthracyclines in cardiomyocytes bind to all membrane structures — mitochondria, nuclei, and the sarcoplasmic reticulum. At the same time, mitochondria are one of the main target organelles. Cytostatics cause their swelling and various damage to the outer and inner membranes. The accumulation of free oxygen in myocardial cells as a result of the toxic action of

anthracyclines and their decomposition products leads to damage to the lipid layer of the cardiomyocyte membranes, which reduces the electrical strength of the membranes, provokes the appearance of potential differences and leads to electrical breakdown of the membrane. The detector of the violation of the structure, function and electrical characteristics of cell membranes is the decrease in the rate of activation of the ventricles, reflecting the slowing of myocardial coverage with excitation and the inhomogeneity of its electrophysiological properties.

Thus, in patients with breast cancer with no changes on the ECG after administration of doxorubicin at a dose of 274.54 mg / m<sup>2</sup>, the rate of ventricular activation is an early, informative marker in the timely prediction of electrical instability of the myocardium. The value of the activation rate of the ventricles of the heart 42.3 s<sup>-1</sup> and below should be considered as critical for the diagnosis of electrical instability of the heart in patients with breast cancer in doxorubicin treatment, until more serious electrical maladjustment developed, manifested by pathological abnormalities on a standard ECG.

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