

## HEART RHYTHM DISORDERS: ETIOLOGY, PATHOGENESIS, CLINICAL PRESENTATION, DIAGNOSIS, TREATMENT

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**Abstract:** Heart rhythm disorders are one of the most common types of disorders, and their frequency cannot be accurately estimated [20]. Temporary rhythm disturbances occur in most healthy people. When diseases of internal organs occur, conditions are created for the development of heart rhythm disorders, which sometimes become the main manifestation of the clinical manifestation of the disease, for example, in thyrotoxicosis, coronary artery disease. Arrhythmias complicate the course of many cardiovascular diseases.

The term "cardiac arrhythmia" refers to arrhythmias and heart blocks. Arrhythmia - disturbances in the frequency, regularity and consistency of heartbeats. Violation of the conduction of excitation causes the development of heart blocks.

**Key words:** Excitation wave rotation ( re-entry ), Impulse conduction disorder, Combination of changes.

All arrhythmias are the result of changes in the basic functions of the heart: automaticity, excitability and conduction. They develop when the formation of the cell action potential is disturbed and the speed of its conduction changes as a result of changes in potassium, sodium and calcium channels. Disruption of potassium, sodium, and calcium channels depends on sympathetic activity, acetylcholine levels, muscarinic M2 receptors, and ATP.

### **Mechanisms of heart rhythm disorders:**

1. Impulse formation disorder: – sinus node (SU) automatism disorder; - abnormal automaticity and trigger activity (early and late depolarization).
2. Rotation of the excitation wave (re-entry).
3. Violation of impulse conduction.

#### 4. A combination of these changes.

Violation of impulse formation. Ectopic foci of automatic activity (anomalous automatism) can be located in the atria, coronary sinus, along the perimeter of the atrioventricular valves, in the AV node, in the system of His bundle and Purkinje fibers. The occurrence of ectopic activity is facilitated by a decrease in sinus automaticity (bradycardia, dysfunction, sick sinus syndrome (SSNS)).

Violation of impulse transmission. Impairment of impulse conduction can occur in any part of the conduction system of the heart. Impulse pathway blockade is manifested by asystole, bradycardia, sinoatrial, AV and intraventricular blockades. This creates conditions for reintroduction of circular motion.

**Roundabout Circulation** . For the formation of reentry, a closed conduction circuit, a one-way blockade in one of the parts of the circuit, and a slow propagation of excitation in the other part of the circuit are required. The impulse slowly propagates along the knee of the chain while maintaining the conductivity, rotates and enters the knee where the conduction block is present. If the conduction is restored, then the pulse moving in a circle returns to its place of origin and repeats its movement again. Reentrant waves occur in the sinus and AV nodes, in the atria and ventricles, in the presence of additional conduction pathways, and in any part of the cardiac conduction system where excitatory conduction dissociation can occur. can be. This mechanism plays an important role in the development of paroxysmal tachycardia, atrial flutter and fibrillation.

**Trigger activity.** A trace depolarization develops at the end of repolarization with trigger activity or at the beginning of the resting phase. This is due to the disruption of transmembrane ion channels.

Exogenous and endogenous factors such as psychosocial stress preceding neurovegetative imbalance play an important role in the development of arrhythmias that occur in various diseases and conditions, life-threatening arrhythmia in 20-30% of cases [20]. predominance of sympathetic or parasympathetic parts of the autonomic nervous system, toxic effects (alcohol, nicotine, drugs, medicines, industrial poisons, etc.), diseases of internal organs.

Etiology of heart rhythm disorders:

Myocardial damage of any etiology: atherosclerosis of coronary arteries, myocarditis, dilated and hypertrophic cardiomyopathies, heart defects, diabetes mellitus, thyroid diseases, menopause, amyloidosis, sarcoidosis, hemochromatosis, myocardial hypertrophy and chronic hypertension with arterial toxicosis. , nicotine, drugs, industrial substances (mercury, arsenic, cobalt, chlorine and organophosphorus compounds), closed heart injuries, involutive processes during aging.

SU and damage to the conduction system of the heart of congenital and acquired origin, for example, SSSU, sclerosis and calcification of the cardiac fibrous skeleton, and primary sclerodegenerative

damage to the conduction system of the heart with the development of AV and intraventricular blockades. , additional conduction pathways (for example, WPW, CLC syndromes).

Heart valve prolapse.

Heart tumors (myxomas, etc.).

Pericardial diseases: pericarditis, pleuropericardial adhesions, pericardial metastases, etc.

Disturbance of electrolyte metabolism (imbalance of potassium, calcium, sodium, magnesium).

Mechanical irritation of the heart (catheterization, angiography, heart surgery).

Reflex effects of internal organs in swallowing, straining, changing body position, etc.

Disorders of nervous regulation of the heart (vegetative dystonia syndrome, organic lesions of the central nervous system).

Under stress (with the development of hyperadrenaline, hypokalemia, stress-ischemia).

Idiopathic heart rhythm disorder.

Examination of a patient with cardiac arrhythmia includes the patient's questioning, clinical and instrumental research methods. It is aimed at identifying the causes of arrhythmia development, adverse factors that may contribute to their development in the future, correctly identifying the types of arrhythmia, diagnosing the condition of the heart (valvular apparatus, size of heart chambers, wall). thickness, shrinkability).

When questioning the patient, pay attention to the anamnestic information: the first appearance of unpleasant sensations in the heart area and the events accompanying it; diagnosis of objective disorders of the cardiovascular system and other organs and systems that can lead to the development of heart rhythm disorders (if implemented); previous treatment and its effectiveness; the dynamics of the development of symptoms until the patient consults a doctor. It is very important to know whether the patient has bad habits, occupational hazards, what diseases he has, as well as his family history. It is important to determine the complaints of patients, because heart rhythm disorders are often accompanied by unpleasant feelings. They are determined by the type of rhythm disorder, the degree of hemodynamic disorders and the nature of the main disease. The most common complaints of patients suffering from arrhythmia are unpleasant sensations in the heart area: palpitations (feeling of rhythmic or irregular heartbeat), interruptions, the feeling of freezing and "stopping" of the heart, various pains or a feeling of tightness, sensation of heaviness in the chest, etc. Sensations can have different duration and frequency, can develop suddenly or gradually, periodically or without a specific pattern. In addition, severe weakness, headache, dizziness, nausea and syncope may occur, which is an indicator of the development of hemodynamic disorders. When the contractility of the left heart decreases, shortness of breath, coughing and suffocation are observed. The appearance or development of heart failure due to arrhythmia is unfavorable prognostically.

Heart rhythm disturbances are often accompanied by feelings of fear and anxiety. In some patients, the arrhythmia is asymptomatic.

Clinical studies show that the patient's condition can vary depending on the type of disorder and the patient's initial condition (from satisfactory to severe). Manifestations of hypoxic encephalopathy up

to possible lethargy, loss of consciousness (fainting), coma. Disorders of the autonomic nervous system are manifested in the form of restlessness, anxious behavior, skin discoloration, sweating, polyuria, defecation, etc. The color of the skin can be pale or hyperemic, especially in case of arterial hypertension, cyanotic in heart failure. In left ventricular heart failure, physical examination of the respiratory system reveals changes - weakening of vesicular breath or hard breathing, accompanied by wet, silent, sometimes dry wheezing. In this case, the emphasis of the second tone on the pulmonary artery can be determined. The study of the cardiovascular system often reveals changes in heart rate (HR) and heart rate - increase or decrease, heart sounds and pulse wave rhythm disturbances. The volume of tones changes, for example, different volumes of the first tone with atrial fibrillation (AF), amplification of the first tone with ventricular extrasystole, weakening with paroxysmal supraventricular tachycardia (PVT). A decrease in pulse filling is determined by vascular insufficiency with AF, often pulse failure occurs; Changes in blood pressure are often observed - hypotension or hypertension. In right ventricular heart failure - liver enlargement and pain. With a decrease in renal blood flow - oliguria. Thromboembolic syndrome may also develop.

Instrumental research methods. Electrocardiography remains the leading method for detecting heart rhythm disorders. Both single-stage and longer studies are used: 3 minutes, 1 and 24 hours. For example, in patients with coronary artery disease, ventricular extrasystoles are detected in routine ECG in 5% of cases, in 3-minute recording - in 14%, in 1-hour recording - in 38% of patients over 24 years of age. hours - in 85% of patients [20]. 24-hour Holter ECG monitoring provides research in various conditions (during physical exercise, during sleep, during meals, etc.), which allows to identify the triggering factors in the development of arrhythmia. Holter monitoring allows qualitative and quantitative assessment of cardiac arrhythmias. Tests with dosed physical activity are used to clarify the diagnosis of ischemic heart disease, to determine the connection of rhythm disorders with angina pectoris and physical activity, to evaluate the effectiveness of therapy, as well as the arrhythmogenic effect of drugs. Transesophageal ECG is used to diagnose and treat transient or permanent CVS if ECG is not effective enough to diagnose ventricular premature beat syndrome. It is not always possible to obtain the necessary information using this method, so the most reliable method is electrophysiological research inside the heart, which includes recording of endocardial ECG and programmed cardiac pacing (ECS).

Principles of antiarrhythmic therapy. Treatment tactics depend on the severity of the disease, the prognostic value of heart rhythm disorders, and the presence of family history. The patient does not need antiarrhythmic therapy for asymptomatic rhythm disorders, normal heart size and contractility, and high tolerance to physical activity. These are, for example, disorders such as sinus bradycardia (in the absence of heart disease and normal hemodynamic parameters), pacemaker migration, sinus arrhythmia, slow ectopic rhythms. In this case, clinical observation, preventive measures and elimination of bad habits are necessary. Etiotropic treatment of arrhythmias (treatment of the main disease that caused the development of rhythm disorders) is effective in eliminating them in some cases. "Basic" therapy is aimed at creating a favorable electrolyte background for the effect of antiarrhythmic drugs (AAT) [12]. In the treatment of paroxysmal supraventricular tachyarrhythmias, the use of reflex stimulation of the vagus - "vagal tests" is effective. If there is a real risk of the patient's death with severe rhythm disturbances, progressive deterioration of hemodynamic parameters (heart failure, vascular failure), electrical impulse therapy (EPT) and a pacemaker are used. There are surgical methods of treatment of certain types of arrhythmias (ventricular tachyarrhythmias resistant to antiarrhythmic drugs, AF, RV syndrome with treatment-resistant attacks

of supraventricular and ventricular tachycardia, combination of RV and SSSU syndromes) and radiofrequency catheter ablation.

Pharmacotherapy for cardiac arrhythmias is common and used in 85–90% of patients with arrhythmias [20]. A wide range of drugs with different mechanisms of action allows choosing the most effective one for the treatment of certain types of arrhythmias. The mechanism of action of AAP is blocking sodium, calcium, potassium ion channels, which leads to changes in the electrophysiological properties of the myocardium. Many AAPs act on different transmembrane ion channels simultaneously. Currently, the classification, which includes 4 classes of AAP, is generally accepted (Table 1). If any antiarrhythmic drug is ineffective, the next drug is selected from another group. When prescribing an AAP, the instructions for prescribing a particular drug must be clearly defined. The possibility of an arrhythmogenic effect of AAP should be considered.

Against the background of many synthetic drugs, a special place is occupied by the herbal drug Allapinin (A), which is a hydrobromide of the alkaloid lappaconitine obtained from the aconite of the butter family. According to the mechanism of action, A is a fast sodium current inhibitor and belongs to the IC class of AAP. It slows the conduction of impulses through the atrium and the His-Purkinje system, unlike most class I AAPs, it does not inhibit the automaticity of the sinus node; A causes blockade of abnormal conduction pathways, in some cases achieving their "complete chemical destruction", which makes it particularly effective in the treatment of patients with WPW syndrome, including patients resistant to other AAPs. For this disorder, the effectiveness of A reaches 80%. A has no negative inotropic and hypotensive effects. The listed properties of the electrophysiological effect of A significantly distinguish it from currently used AAPs. The activity of the drug is shown against atrial and ventricular cardiac arrhythmias. The greatest effectiveness of Allapinin is observed in the prevention of paroxysms of supraventricular tachyarrhythmias (MA, TP and PVT). In such cases, its efficiency reaches 77.8%. The effect in the treatment of ventricular extrasystole is 71.4%. The use of A is indicated in the treatment of arrhythmias during myocardial infarction. The advantage of the drug is its low arrhythmogenic activity. The drug is well tolerated. It is prescribed orally in tablets for a long time. A solution for parenteral use is also available.

### **Brief description of some types of heart rhythm disorders**

Fibrillation (atrial fibrillation). The frequency of AF is about 80% of all supraventricular arrhythmias [6]. According to the Framingham study, MA occurs in 0.3–0.4% of the adult population and its incidence increases with age [24]. It is customary to distinguish two main forms of MA: chronic and paroxysmal. In approximately 90% of patients with chronic AF, the cause is organic heart disease, the most common of which are organic heart defects (30%) and ischemic heart disease (20%). In the paroxysmal form, 60% of patients are people with idiopathic MA [6]. Thyrotoxicosis and dysfunction of the autonomic nervous system, in particular, vagotonia, are important among the diseases that do not cause gross morphological changes in the atrial myocardium and lead to the development of AF. The mechanism of development of MA is the re-entry of the excitation wave, and several re-entry loops work. ECG signs of atrial fibrillation are characterized by the absence of a P wave in all directions, a frequency of 350-700 random f waves of various shapes and amplitudes per minute, and an irregular rhythm of QRS complexes. rule, has an unchanged appearance (Fig. 1a). In most cases, the ventricular rate is 100-160 per minute, but there are also normosystolic and bradysystolic forms.

According to modern ideas about the mechanisms of MA, AAPs (class I and III drugs) that block potassium and sodium channels are used for its treatment.

Rice. 1. ECG for some types of heart rhythm disorders (according to the book: AV Strutynsky "Electrocardiography: analysis and interpretation", 1999)

Atrial flutter (AF). The frequency of this type of rhythm disturbance is about 10% of all supraventricular tachyarrhythmias [6]. The electrophysiological mechanism of TP is reentry. The most common etiological factors are organic heart defects, ischemic heart disease and arterial hypertension. ECG signs: identical regular sawtooth-shaped atrial F waves, frequency 200-400 beats per minute (not always), regular ventricular rhythm in most cases, presence of unchanged ventricular complexes, each of them before. known, often constant, by the number of atrial F waves. Sodium (class I) and potassium channel blockers (class III AAP) are used to treat TP.

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