Prediction of Cardiac Complications in Patients with Coronary Heart Disease

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Abstract: The literature review presents modern approaches to the prevention of coronary heart disease , based on preclinical diagnosis of predictors of the highest probability of developing cardiac events (sudden death, myocardial infarction, arrhythmias and cardiac conduction disturbances). Instrumental methods (ECG, ECHOCG, stress tests, stress echocardiography) and laboratory biochemical diagnostics (indicators of blood coagulation and fibrinolytic systems, lipid peroxidation, antioxidant protection, kallikrein-kinin system) can be used as probable criteria.

Keywords: ischemic, heart, disease, acute myocardial, infarction, acute coronary syndrome, unstable angina.

Introduction

The twentieth century can be characterized as an era of many major advances in the field of medicine and, in particular, in the diagnosis and treatment of patients with coronary heart disease (CHD). And if there are no fundamental disagreements in the choice of the method and tactics of treating patients with coronary artery disease, then the aspects of prevention and early preclinical diagnosis, prognosis of the disease remain controversial and little studied. In turn, this circumstance largely determines the mortality rate. Thus, according to the latest data from the Committee of Statistics of the American Heart Association, lethality from coronary artery disease has slightly decreased compared to previous years, but the incidence remains extremely high [1]. A similar trend is observed in some European countries [2]. Nevertheless, WHO experts express very serious concern regarding global mortality and morbidity [3]. If in economically developed countries cardiovascular diseases are responsible for approximately 1 death out of every 5 [4], then in developing countries their share in the structure of total mortality reaches 80% [5]. Given the high prevalence of cardiovascular pathology and associated mortality and morbidity, one of the main goals of modern cardiology is to prevent recurrent cardiac events. The fundamental principle of preventive medicine is the early application of different therapeutic strategies depending on the level of risk and, consequently, the prognosis. Thus, risk assessment is an integral component of preventive care. Risk is commonly understood as cardiovascular death and myocardial infarction, and in some cases other cardiovascular outcomes [6]. Basic principles of risk stratification of cardiac complications in documented coronary artery disease. The choice of treatment tactics for a "coronary" patient, which can largely determine his fate, is the daily work task of a cardiologist. The entire process of predicting the risk of developing negative clinical outcomes is aimed at making the right decision [7].

Main part. This goal is common to the entire spectrum of clinical situations in atherosclerotic lesions of the coronary bed. At the same time, only individual, clearly defined models that have received an evidence base in a specific clinical scenario should be developed and applied for various categories of patients. So, for example, standards

established as prognostically unfavorable for patients with stable forms of coronary artery disease, it is completely unacceptable to automatically transfer to patients, say, with acute coronary syndrome or to those who have undergone any of the methods (endovascular , surgical) of direct myocardial revascularization . Similarly, risk stratification schemes after coronary artery stenting should not be used in patients after coronary artery bypass grafting.

In this regard, many years of efforts are understandable, applied to the study of predictors of the probability of major cardiac events (sudden death, acute myocardial infarction, and unstable angina), their use as prognostic criteria for the formation of homogeneous groups and, in fact, risk stratification [8]. From these positions, the study of the state of the systems of the "rapid response of the body" allows you to adequately and timely determine the tactics of treatment and methods of prevention. One of such "quick response" systems is kallikrein - kinin (KKS), blood coagulation and fibrinolytic systems, as well as lipid peroxidation processes [9]. Principles of risk stratification in patients with coronary artery disease based on general clinical, laboratory and biochemical criteria. Among general clinical parameters, a high risk of negative outcomes is associated with age; gender (long-term prognosis in women is somewhat worse); the presence of major risk factors for coronary artery disease (arterial hypertension, diabetes mellitus, smoking, metabolic syndrome, hypercholesterolemia). History data and physical examination provide valuable prognostic information for stratification in the course of daily medical practice without additional financial/time cost and risk to the patient, and in "symptomatic " patients form the basis for most decisions and actions [6,10].

First of all, the clinical manifestations of the underlying disease deserve attention, and the dependence is quite obvious: the more severe the functional class of angina pectoris, the higher the likelihood of complications, especially in the absence of an adequate response to treatment. Moreover, frequent and severe angina attacks and the presence of ECG changes at rest are considered independent predictors of death and myocardial infarction [6,10].

An important role is played by indications of an already existing cardiovascular pathology, in particular, a past myocardial infarction, mainly of anterior localization; congestive heart failure; arrhythmias, including and sinus tachycardia; damage to other arterial basins or myocardial hypertrophy [6,10]. In such cases, previous diagnostic and therapeutic procedures are of interest. At the same time, "satisfactory" results of previous tests are not significant. Noteworthy are previous studies on the possibility of using some laboratory and biochemical research methods. This is the determination of indicators of the blood coagulation and fibrinolytic systems, the kallikrein-kinin system, lipid peroxidation and antioxidant protection [9,11,12]. Principles of risk stratification in patients with coronary artery disease based on instrumental diagnostic methods. The key links in risk stratification are non-invasive diagnostic methods, because their main purpose is to clarify the prognosis in patients with an average risk category, the most impressive of the groups in terms of the number of patients included. Based precisely on the results of a non-invasive instrumental examination, the doctor can reasonably change the initially established risk category. The presence of ECG changes at rest in a patient with stable angina pectoris is responsible for the increased risk of cardiac events compared with patients without ECG abnormalities. Prognostically unfavorable factors include : signs of a previous myocardial infarction (mainly, the registration of a pathological Q wave); blockade of the left leg of the bundle of His; signs of LV hypertrophy; AV block II-III degrees; atrial fibrillation [6,10].

The most significant predictor of long-term survival is LV contractility, which is routinely assessed by echocardiography at rest. In patients with stable angina, mortality increases as the ejection fraction (EF) of the LV decreases. With resting EF ≤ 35% annually mortality exceeds

3%. The dimensions of the ventricles also have an important prognostic value, which, according to some data, is superior to the results of exercise tests in patients with stable angina [6,10]. The leading positions as an important diagnostic element with a powerful set of prognostic capabilities continue to be occupied by tests with dosed physical activity. Stress test results should only be used in conjunction with clinical data [6,10].

Identification of stress-induced ischemia is a sign that suggests a high probability of the presence of coronary artery disease, but one cannot speak of risk based solely on this parameter. The fact of the presence of stress-induced ischemia during a test with dosed physical activity has a low positive prognostic value [13,14]. It is possible to build a forecast only by analyzing the totality of data. As additional information, it is recommended to use the lack of an adequate increase in blood pressure and the appearance of arrhythmias in response to exercise [8,15]. Independent predictors of recurrence of cardiac events are: inability to perform stress test and low exercise tolerance [16,17], which are reflected in the integral prognostic indicator - the Duke index [16]. The occurrence of ischemia at a low threshold of exercise tolerance [18] or a high risk on the Duke scale [19]] suggest serious limitations in the ability to increase coronary blood flow. As a rule, this is the result of significant coronary artery disease and is closely associated with a high risk of adverse outcomes. On the other hand, according to the work of a number of research groups, the negative predictive accuracy of the stress test is quite high, and a negative result of the study implies a low probability of developing negative clinical outcomes, thereby providing a favorable prognosis [15,20,21]. As with any other diagnostic test, the exercise test has certain limitations. So, according to the experience of Italian researchers, out of approximately 5-6 patients referred for a stress test, one (for various reasons) is not able to perform the load of the required intensity, in another case the criteria for an unambiguous interpretation of the test results are not achieved, and in another in one case, as a rule, the ECG is not amenable to interpretation [21].

In recent years, studies have been carried out on the possibility of express spectral analysis of variations in the RR cardio interval , which makes it possible to identify an imbalance in the central and peripheral links of regulation with a decrease in the stability of the heart rate control system, as well as the development of irreversible changes in the myocardium. The authors believe that changes in heart rate variability are an independent predictor of the possible development of heart rhythm disturbances, sudden death, or evidence of a prognostically unfavorable outcome of myocardial infarction [22]. The combination of a stress test with modern imaging methods (ultrasound and radionuclide) allows one to evaluate the function and perfusion of the myocardium against the background of ischemia, which provides a higher accuracy of prognosis [23]. Radionuclide research methods have played an important role in the diagnosis of coronary artery disease since the 1970s, as integral elements of prognosis assessment based on regional blood flow disorders, coronary perfusion, and LV function, and to the present, they firmly hold their positions in the minds of physicians [23-25].

The result of the study is considered positive if defects in the accumulation of radiopharmaceuticals appear. drug in different parts of the myocardium, which, according to some data, is associated with a significant increase in the number of major cardinal complications during a year of observation [26]. In 1935, Tennant R. and Wiggers C. in a series of experimental work showed that coronary artery occlusion instantly leads to a violation of the kinetics of the myocardial wall. Based on many subsequent studies, transient myocardial a synergy has been recognized as the earliest, most sensitive and specific marker of ischemia, undoubtedly more accurate than ECG changes and pain [27,28]. This basic concept underlies stress echocardiography, which combines 2D echocardiography with physical, pharmacological, or electrical stress agents [29]. The diagnostic endpoint for

myocardial ischemia is the induction of transient regional changes in cardiac function during stress. A transient regional imbalance between myocardial oxygen demand and delivery usually results in myocardial ischemia, the signs and symptoms of which can be used as a diagnostic tool. Myocardial ischemia is the result of a typical "cascade" of events, in which various markers are ranked hierarchically in a well-defined time sequence [30].

Heterogeneity of blood flow, especially between subendocardial and subepicardial perfusion, is a harbinger of ischemia, followed by myocardial metabolic changes, diastolic dysfunction, and only at a later stage ECG changes, left ventricular (LV) dysfunction and pain. The pathophysiological concept of the ischemic cascade translates clinically into a sensitivity gradient of the various clinical markers of ischemia available, from chest pain at the least to regional perfusion failure, the most sensitive. In the non-invasive detection of coronary artery disease, this conceptual framework provides an undeniable advantage to imaging techniques based on perfusion assessment or stress echocardiography over ECG. At the same time, myocardial wall motion disorder is more specific than changes in coronary blood flow and/or perfusion reserve [31].

Stress echocardiography with dosed exercise, high doses of dobutamine , and high doses of dipyridamole are comparable not only in diagnostic accuracy, but also in sensitivity [31–33]. Therefore, the indications for performing one or another type of stress echocardiography can be individualized, which makes it possible to avoid relative and absolute contraindications for each of the tests. Given the many factors that affect the degree of diagnostic accuracy, reliable information about the comparative value of different tests can only be obtained by directly comparing the results of examining a sufficient number of patients under the same conditions. Compared to standard controlled exercise ECGtest, stress echocardiography has the advantage in terms of sensitivity and especially specificity. In the ACC/AHA Guidelines for the Management of Stable Angina, the advantages of stress echocardiography over perfusion echocardiography scintigraphy results in higher specificity, versatility, simplicity and ease of use, as well as lower cost [34].

The advantages of the perfusion stress test include a higher technical success rate, higher sensitivity (especially in isolated circumflex artery disease), greater accuracy in a large area of impaired LV kinetics at rest, and a more powerful database for assessing prognosis [35,36]. According to the experts of the European Society of Cardiology "In general, stress echocardiography and perfusion stress scintigraphy , whether using metered exercise or pharmacological tests (dobutamine , dipyridamole), have very similar points of application. The choice of a diagnostic method largely depends on the available capabilities and experience" [10].Magnetic resonance imaging (MRI) is one of the latest technological developments in cardiac imaging. The advantage of this technique is associated with the absence of ionizing radiation. Compared to echocardiography, its cost is much higher, and its availability is lower. Despite these limitations, MRI becomes an alternative to stress echocardiography , but only when stress echocardiography does not give the required results, or it is not possible to perform it [37].

To date , echocardiographic (including under load) criteria have been systematized, unified research protocols have been developed and adopted, applicable to the current level of development of science and industrial resources [38]. Possibilities of preventive laboratory and biochemical diagnostics (indicators of kallikrein-kinin and blood coagulation system, lipid peroxidation and antioxidant protection), echocardiography diagnostics, providing, in addition to information about LV function, obtaining information about myocardial perfusion, contrast stress echocardiography , fractal express analysis of the dynamic stability of extra cardiac regulation of heart rate puts these methods out of competition in the

stratification of the risk of cardiac complications in patients with coronary artery disease [9,22,29,30] .

Conclusion _ Thus, the presented review of literature data on modern approaches to predicting cardiac complications indicates the relevance of the problem, the ongoing search for prognostic criteria for the probable and most severe and common complications of coronary heart disease. In this regard, as probable criteria can be used in addition to clinical, laboratory and biochemical (indicators of coagulation, fibrinolytic and kallecrein-kinin blood systems, lipid peroxidation and antioxidant protection, as well as instrumental high-tech diagnostic methods (ECG, echocardiography, stress tests, stress echocardiography, computed tomography, coronary angiography). diagnosis and prognosis is the key to effective adequate prevention and treatment.

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