

## Physiopathological Considerations of Ischemic Heart Disease and its Risk Factors

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### Abstract

Cardiovascular diseases, in its many variants and manifestations, account for the highest number of deaths in the world. Ischemic heart disease has a multifactorial origin, therefore, one risk factor must be considered in the context of the others. They are divided into two large groups: non-modifiable such as age, sex, family history and modifiable such as high blood pressure, atherosclerosis, dyslipidemia, smoking, diabetes, obesity and sedentary lifestyle. Expanding the study of the influence of each cardiovascular risk factor in the development of ischemic heart disease helps to reduce morbidity and mortality, and devise strategies to control the disease.

**Keyword:** Ischemic Heart Disease; Risk Factor; Atherosclerosis; Hypertension; Cardiovascular Diseases

### Introduction

Cardiovascular diseases contribute the highest number of annual deaths in the entire planet, which is why they are considered a true scourge of humanity; within these, ischemic heart disease (IHD) takes on special relevance. The disease is a specific form of myocardial disease caused mainly by atherosclerotic coronary insufficiency, which is produced by the imbalance between the requirements of the heart muscle and the coronary flow due to the atherosclerotic compromise of the coronary arteries and the consequent decrease in oxygen supply myocardial disease that causes modifications in cell metabolism and its function, with a particular clinical expression of acute coronary accidents. The World Health Organization (WHO) includes different entities within the CI; cardiorespiratory arrest, angina pectoris, acute myocardial infarction, heart failure and arrhythmias [1].

There have been multiple research efforts in its causal detection and there is a consensus of the multifactorial nature in the genesis of this process, where obviously its fundamental etiological factor is coronary atherosclerosis, together with coronary spasms, without forgetting the risk factors atherogenic, composed more dynamically by those conditionals that precede the disease maintain a significant statistical correlation and strong predictive power, which establishes the pathogenic mechanisms based on basic and clinical observations.

Such factors are constituted, to a greater degree, by arterial hypertension, diabetes mellitus, and hyperlipoproteinemias; and to a lesser degree, they would be made up of smoking, diets rich in cholesterol and fats, obesity, sedentary lifestyle, the stress of modern life with the typical type A behavioral pattern, described by Rosenman and others, and heredity; the latter is vitally important for health professionals because it cannot be modified, as can age and gender [2].

All of the above, in a general sense, marks the polygenicity in the pathogenesis of atherosclerosis. The WHO defines the term of atherosclerosis, as a process that denotes the result of the reaction of a genetically conditioned organism in interaction with its environment in a period of time throughout life. For all the above and without relegating modifiable factors (dependent and independent) to a lower level, priority is given to factors that until now are not modifiable and within these to family inheritance [4,5].

Despite the extraordinary advances that have been made in the world in the diagnosis, treatment and control of known coronary risk factors in recent years, global cardiovascular risk control has not yet been achieved.

The same happens in Cuba where ischemic heart disease (IC) is one of the main causes of death in the country, despite showing indicators comparable to those of developed countries. The incidence and prevalence of coronary heart disease is high in the country, causing a mortality of 142.3 per 100,000 inhabitants in 2006 and a total of 11,364 deaths in males, with a ratio of rates by sex M/F of 1,2. In the same period, the years of potential life lost, as a consequence of cardiovascular diseases, amount to 10.8 and the mortality rate has increased to values of 114 per 100,000 inhabitants in 1970, to 140.6 per 100,000 inhabitants in 2005 [6,7].

What are the main preceding risk factors for ischemic heart disease? This problem constitutes a public health problem for developed countries and Third World nations, due to its prevalence, great burden of disability, high mortality and economic costs, the objective was to describe the risk factors that trigger the disease ischemic heart disease.

### What is ischemic heart disease?

Ischemic heart disease (IC) or coronary artery disease, the main disease of the heart, is the basic cause of morbidity and mortality worldwide. It is due to an inadequate blood supply to the heart, mainly caused by a hardening and loss of elasticity of the coronary arteries that favors the deposit of atheroma plaques on their internal (intimate) surface. As the lumen or interior of the vessel is reduced by atherosclerosis, blood flow to the myocardium decreases, characteristically causing chest pain [8].

### Cardiac morphophysiology

The heart is the first functional organ of the Cardiovascular System, it begins its development from mesodermal cells located in the cephalic pole of the embryo, called the cardiogenic field, it rests on the diaphragm, near the midline of the thoracic cavity, the anterior face is located behind the breastbone and ribs. It is about the size of a closed fist and is the strongest muscle in the body; In resting conditions, it contracts 60 to 100 times per minute, which is known as the heart rate, and in this period of time it pumps about five liters of blood, which is the cardiac output.

### The cardiac organ consists of four layers:

1. Pericardium: Membrane that surrounds and protects the heart, in addition to holding it in position.
2. Epicardium: Outer layer, is a thin, transparent sheet known as the serous pericardium.
3. Myocardium: Middle layer formed by cardiac muscle tissue, responsible for the pumping action.
4. Endocardium: Inner layer, lines this part of the heart and forms the mitral and tricuspid valves.

The heart muscle is biogenic, it excites itself, unlike, for example, skeletal muscle that needs a conscious or reflex stimulus. Rhythmic contractions of the heart occur spontaneously, but their frequency can be affected by nervous or hormonal influences, by physical exercise, or by the perception of danger [9].

Each heartbeat triggers a sequence of events called cardiac cycles, each cycle consisting mainly of three stages: atrial systole, ventricular systole, and diastole.

During atrial systole, the atria contract and project blood into the ventricles, once the blood has been expelled from the atria, the atrioventricular valves (located between the atria and ventricles) close, this prevents reflux (in return or return) of blood to the atria [10].

Ventricular systole involves the contraction of the ventricles, expelling blood into the circulatory system. Once the blood is expelled, the two sigmoid valves, the pulmonary on the right and the aortic on the left, close. Lasts approximately 0.3 seconds. Finally, diastole is the relaxation of all parts of the heart to allow the arrival of new blood. It lasts approximately 0.4 seconds [11].

### Pathophysiological considerations

When oxygen demands are increased and a higher cardiac output is required as occurs during physical activity or emotions, in a myocardium or muscular layer of the heart with blood compromise due to atherosclerosis of the coronary arteries, chest pain occurs that it may or may not radiate to the left or right upper limb, jaw, shoulder, back or epigastrium (pit of stomach), often accompanied by a sensation of tightness and impending death [12].

If the lack of oxygen or hypoxia is transitory, it is triggered by exercise and emotions, it is relieved with rest and sublingual nitroglycerin (under the tongue), but it remains unchanged; that is, without changing its characteristics for a month, it is called typical or classic angina pectoris. This pain constitutes the first symptom of IC in 50% of cases, it generally has a good prognosis, but the highest risk groups should be identified. If myocardial hypoxia persists, it causes necrosis or death of myocardial cells supplied by the blocked artery, known as acute myocardial infarction (AMI), a dangerous condition that requires admission to an intensive care unit [13].

Acute myocardial infarction can be caused by the formation of a blood clot (thrombosis) in a branch of the coronary arteries or by vasospasm. If the AMI is massive or a severe arrhythmia occurs, sudden cardiac death can occur. Most patients with such acute conditions tend to die before reaching the hospital, so basic resuscitation maneuvers are recommended on the scene. Another manifestation of IC is silent, that is, without pain, observed with some frequency in the elderly and diabetics [14].

This disorder is much more common in sedentary, obese, dyslipidemic people, with type 2 diabetes mellitus (DM-2), hypertensive people, smokers and in the elderly who are considered to be carriers of cardiovascular risk [15].

### Approach to risk factors

Cardiovascular risk is defined as the probability of suffering a cardiovascular event in a certain period, which is usually established in 5 or 10 years, it also includes the probability of suffering from cerebrovascular and peripheral arterial disease and constitutes one of the most important and controversial pharmacological therapeutic intervention, especially in the case of arterial hypertension and hyperlipidemia or dyslipidemias [16].

Risk factors are those biological signs or acquired habits that occur more frequently in patients with a specific disease. Cardiovascular disease has a multifactorial origin, and one risk factor must be considered in the context of the others [17].

Classic or traditional cardiovascular risk factors are divided into 2 large groups:

1. Non-modifiable: Age, sex and family history.
2. Modifiable: Arterial hypertension, atherosclerosis, dyslipidemia, smoking, diabetes, obesity and sedentary lifestyle [18].

Blood pressure is the product of cardiac output and systemic vascular resistance. Therefore, the determinants of blood pressure are factors that affect cardiac output and the physiology and structure of the arterioles. For example, increasing the viscosity of the blood has significant effects on the work required to pump a given amount of blood and can lead to a persistent increase in blood pressure. The malleability conditions of the blood vessel wall (pulsatile components) affect the speed of blood flow, therefore they also have a potential relevance with regard to the regulation of blood pressure. In addition, changes in the thickness of the vascular walls affect the amplification of peripheral vascular resistance in hypertensive patients, which leads to reflection of waves in the direction of the aorta and opposite to blood flow, increasing systolic blood pressure [19].

The relationship between arterial hypertension and cardiovascular disease is strong, continuous, gradual, consistent, predictive and independent, so it is important to adopt an adequate treatment strategy that allows the reduction of blood pressure regardless of the drug used [20].

The arterial hypertension continues to be one of the most prevalent chronic conditions. Its frequency varies frequently in different countries. Let us cite the example of Spain, which with a prevalence of 45.1% would have approximately 6 million hypertensive patients among its middle-aged population, of which approximately 3.3 million are unaware of the problem. In the United States, HTN affects an estimated 50 million people and contributes to more than 250,000 people dying of target organ damage [21].

Atherosclerosis plays an important role in the development of cardiovascular diseases, and its fundamental cause. A large number of apparently healthy victims suddenly develop a fatal or non-fatal cardiovascular event, and this is the first detectable clinical manifestation of atherosclerosis. A number of changes affect the vascular wall, cause inflammation and endothelial dysfunction, and increase the peripheral blood concentration of biomarkers [22].

The mechanism is based on a response of the vascular bed to the injury. This theory provides that certain injuries, including high blood pressure and hypercholesterolemia, provoke stimuli that cause damage to the endothelium, which is the layer that surrounds the arteries. The result is the release of growth factors that cause the proliferation and growth of arterial smooth muscle and the migration of macrophages to the vascular wall. At the same time, the injured endothelium becomes permeable, admitting the entry of cholesterol and lipids into its intima. These changes lead to the appearance of atheroma plaque, which compromises the diameter of the lumen of the artery. If the plaque cracks or becomes rough, it allows platelet activation leading to thrombus formation, worsening the obstruction [23].

Multiple studies show that about half of cardiovascular events occur in people without evidence of dyslipidemia and 15 - 20% occur in people without any traditional or classic risk factors. Sometimes the first clinical manifestation is the cardiovascular event. With recent advances in the pathophysiology of atherosclerosis, the link between inflammation and atherosclerosis is well established, inflammation is the key element in the atherosclerotic process and contributes in all its stages: initiation, growth and rupture of the atheroma plaque. There are a number of biomarkers reflecting inflammation, hemostasis, thrombosis, and oxidative stress, which have been proposed as potential clinical tools in an effort to improve risk prediction [24].

Smoking is a known cardiovascular and cancer risk factor, even at low levels of exposure. A study shows that smoking is associated with an almost five-fold increase in aortic aneurysms in patients with IC and contributes to 40% of cardiovascular deaths. Smokers have a greater than 50% risk of coronary heart disease than those who do not smoke. Smoking increases the levels of carbon monoxide in the blood which causes damage to the endothelium of the blood vessels. Tobacco also increases the stickiness of circulating platelets. Worldwide, tobacco use is associated with one in five deaths in men and with one in 20 deaths in women over 30 years of age [25,26].

Similarly, other cardiovascular risk factors such as obesity, sedentary lifestyle, dyslipidemia and diabetes mellitus among others, associated with exposure to psychogenic stress, not only can increase blood pressure in the brief flight response, but also adrenaline secreted in the adrenal medulla can induce more important and prolonged changes that together could be responsible for a wide range of cardiovascular problems in which ischemic heart disease plays a predominant role [27].

Currently, new risk factors or emerging risk factors are being investigated, such as lipoprotein a, homocysteine, C-reactive protein, fibrinogen, factor VII, adiponectin and interleukin 6, among others; the most widely used inflammatory marker as a predictor of cardiovascular risk is C-reactive protein [28,29].

Although the impact of individual risk factors is well established and improves the prediction of cardiovascular risk, there is now an increasing emphasis on the treatment of global cardiovascular risk, which requires the evaluation and treatment of multiple risk factors, already that several large-scale epidemiological studies have shown that risk factors have a synergistic, rather than additive, effect on total cardiovascular risk [30].

Risk factors play a prominent role in the course of ischemic heart disease, their knowledge is essential among health professionals to draw strategies in the population and minimize the consequences of ischemic heart disease.

### Conclusion

It is essential to constantly study the risk factors in their entirety as well as the exhaustive preparation in the pathophysiology of Ischemic Heart Disease for greater control by public health personnel, thus providing adequate care and effective treatment to patients affected by these are from the Primary Health Care as the first front of medicine in Cuba.

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