Cardiovascular Disease (I)

Dr. Rafa G. Carretero
Internal Medicine Department
Hospital Universitario de Móstoles

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1 Introduction

The cardiovascular system consists of the heart and blood vessels. There is a wide array of problems that may arise within the cardiovascular system, for example, endocarditis, rheumatic heart disease, abnormalities in the conduction system, among others, cardiovascular disease (CVD) or heart disease refer to the following 4 entities that are the focus of this manuscript:

1. Coronary artery disease (CAD): Sometimes referred to as Coronary Heart Disease (CHD), results from decreased myocardial perfusion that causes angina, acute myocardial infarction (AMI), and/or heart failure. It accounts for one-third to one-half of the cases of CVD.

2. Cerebrovascular disease (CVD): Including stroke and transient ischemic attack (TIA)

3. Peripheral artery disease (PAD): Particularly arterial disease involving the limbs that may result in claudication

4. Aortic atherosclerosis: Including thoracic and abdominal aneurysms

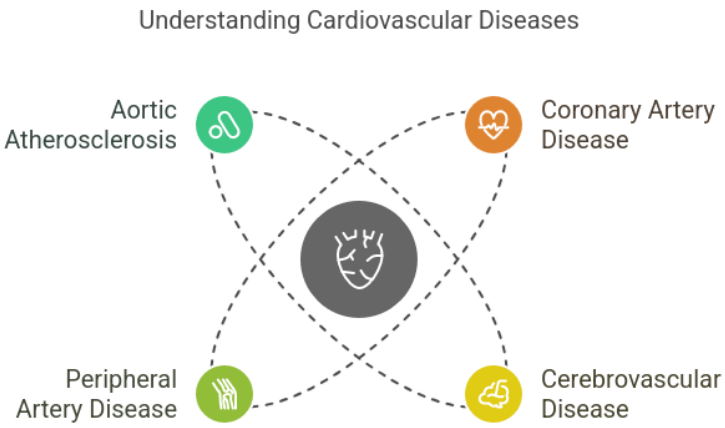

Figure 1: The four main entities included in cardiovascular disease.

2 Etiology

Atherosclerotic disease is the common cause of almost all CV diseases, so addressing risks factors associated to the development of atherosclerosis is most important issue in the pathophysiology of CVD.

We have observed significant and steady increase in CVD rates during the last few decades. Specifically, lower physical inactivity, higher intake of a high-calorie diet, saturated fats, and sugars are associated with the development of atherosclerosis and other metabolic disturbances like metabolic syndrome, diabetes mellitus, and hypertension that are highly prevalent in people with CVD.

There are 9 modifiable risks factors that accounted for 90% of the risk of having a first AMI: smoking, dyslipidemia, hypertension, diabetes, abdominal obesity, psychosocial factors, consumption of fruits and vegetables, regular alcohol consumption, and physical inactivity.

It is worth mentioning the two most important CV studies. The Framingham Heart Study and the Third National Health and Nutrition Examination Survey (NHANES III) found a strong association and predictive value of dyslipidemia, high blood pressure, smoking, and glucose intolerance for the development of atherosclerosis.

Obviously, these findings have been translated into health promotion programs by scientific associations with emphasis on some recommendations to decrease the risk of CVD: avoiding smoking, being physically active, eating healthy, and keeping normal blood pressure, body weight, glucose, and cholesterol levels.

On the other hand, we also have non-modifiable factors as family history, age, and gender, each of them with different implications. Family history, particularly premature atherosclerotic disease (CVD in a first-degree relative before 55 years) is considered an independent risk factor. There is also suggestive evidence that the presence of CVD risk factors may differently influence gender. For instance, diabetes and smoking more than 20 cigarettes per day had increased CVD risk in women compared to men (women are more vulnerable to CVD than men regarding smoking).

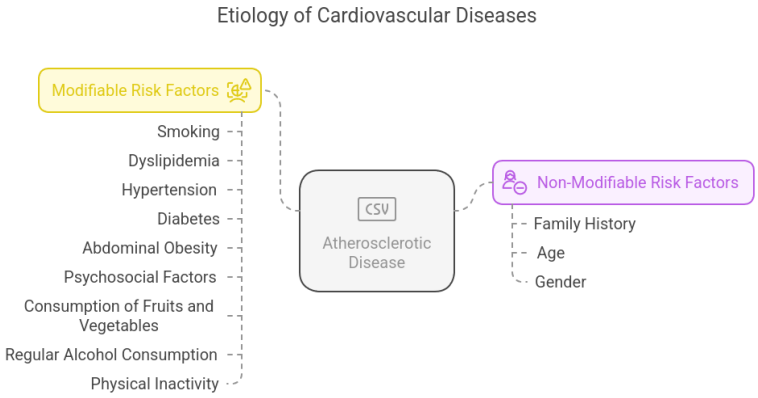

Figure 2: Risk factors for cardiovascular disease.

3 Epidemiology

Cardiovascular diseases (CVD) remain among the 2 leading causes of death in the developed countries with 1 in every 4 deaths, being heart disease the leading cause of death followed by deaths related to cancer. CVD is also the number 1 cause of death globally with an estimated 17.7 million deaths according to the World Health Organization (WHO). The burden of CVD further extends as it is considered the most costly disease with calculated indirect costs of $237 billion dollars per year and a projected increased to $368 billion by 2035.

When studying the age-adjusted rate and acute mortality from CVD, the risk of CVD remains high with a calculated 50% risk by age 45 in the general population. The incidence significantly increases with age with some variations between genders as the incidence is higher in men at younger ages, but this difference in incidence narrows progressively in the post-menopausal state.

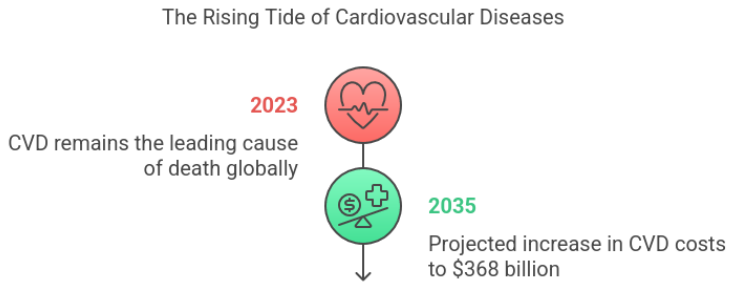

Figure 3: Impact of cardiovascular diseases.

4 Pathophysiology

Atherosclerosis is the pathogenic process in the arteries and the aorta that can potentially cause disease as a consequence of decreased or absent blood flow from stenosis of the blood vessels.

It involves multiple factors dyslipidemia, immunologic phenomena, inflammation, and endothelial dysfunction. These factors are believed to trigger the formation of fatty streak,

which is the hallmark in the development of the atherosclerotic plaque; a progressive process that may occur as early as in the childhood. This process comprises intimal thickening with subsequent accumulation of lipid-laden macrophages (foam cells) and extracellular matrix, followed by aggregation and proliferation of smooth muscle cells constituting the formation of the atheroma plaque. As this lesions continue to expand, apoptosis of the deep layers can occur, precipitating further macrophage recruitment that can become calcified and transition to atherosclerotic plaques.

Other mechanisms like arterial remodeling and intra-plaque hemorrhage play an important role in the delay and accelerated the progression of atherosclerotic CVD.

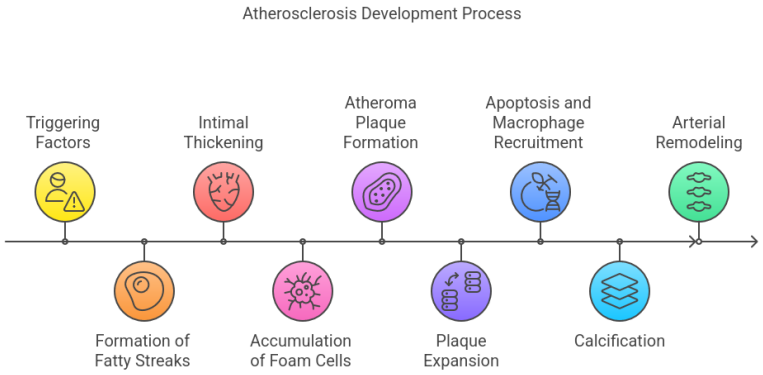

Figure 4: Development of atherosclerosis.

5 Clinical Presentation and Physical Examination

The clinical presentation of cardiovascular diseases can range from asymptomatic (e.g., silent ischemia, angiographic evidence of coronary artery disease without symptoms, among others) to classic presentations as when patients present with typical anginal chest pain consistent of myocardial infarction and/or those suffering from acute CVA presenting with focal neurological deficits of sudden onset.

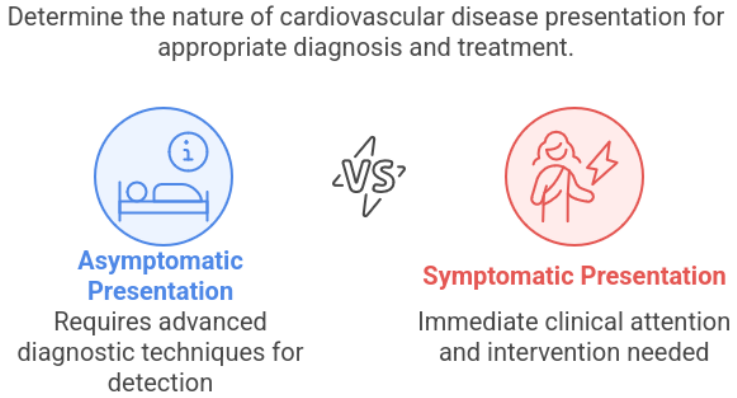

Figure 5: Clinical presentation of CVD.

Historically, coronary artery disease typically presents with angina that is a pain of

substernal location, described as a crushing or pressure in nature, that may radiate to the medial aspect of the left upper extremity, to the neck or the jaw and that can be associated with nausea, vomiting, palpitations, diaphoresis, syncope or even sudden death.

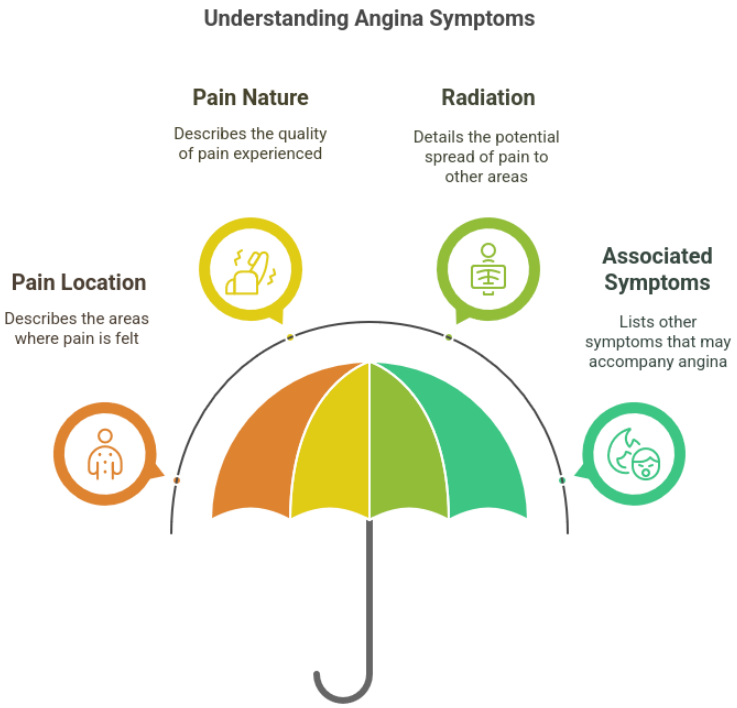

Figure 6: Heart manifestations of CVD: coronary disease.

Neurologic deficits are the hallmark of cerebrovascular disease (ischemic infractions in the brain). Although the specific symptoms depend on the affected area of the brain, the sudden onset of extremity weakness, dysarthria, and facial droop are among the most commonly reported symptoms that raise concern for a diagnosis of a stroke.

Patients with PAD may present with claudication of the limbs, described as a cramp-like muscle pain precipitated by increased blood flow demand during exercise that typically subsides with rest. Severe PAD might present with color changes of the skin and changes in temperature.

Most patients with thoracic aortic aneurysm will be asymptomatic, but symptoms can develop as it progresses to the acute presentation of sudden crushing chest or back pain due to acute rupture. The same is true for abdominal aortic aneurysms that cause no symptoms in early stages to the acute presentation of sudden onset of abdominal pain or syncope from acute rupture.

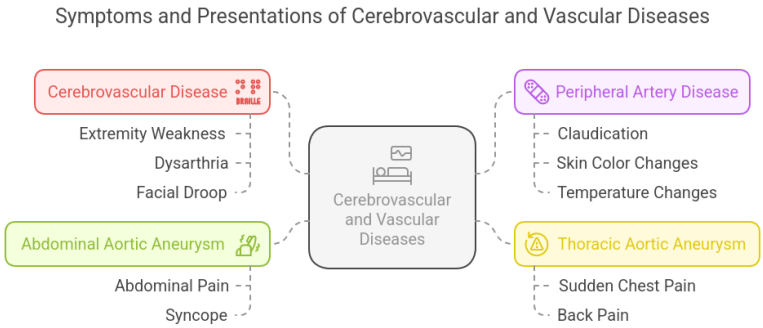

Figure 7: Presentation of cerebrovascular disease.

A thorough physical examination is paramount for the diagnosis of CVD. Starting with a general inspection to look for signs of distress as in patients with angina or with decompensated heart failure, or chronic skin changes from PAD. Carotid examination with palpation and auscultation of carotid pulses, bruits and to evaluate for jugular venous pulsations on the neck is essential. Heart sounds auscultation and palpating peripheral pulses with bilateral examination and comparison when applicable is an integral part of the CVD examination.

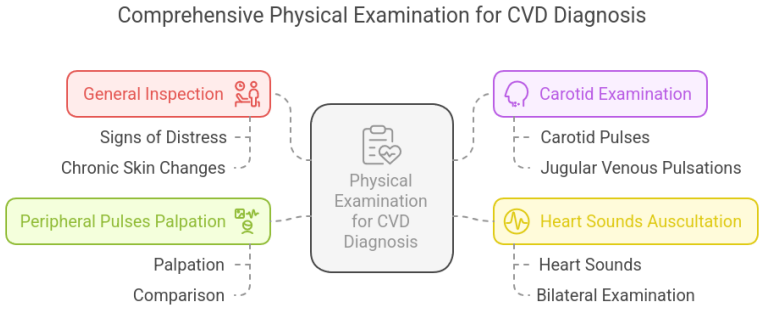

Figure 8: Physical examination.

6 Evaluation at the physician's office

Not only clinical history and physical exam directed to the cardiovascular system are the hallmarks for the diagnosis of CVD. Specifically, the physician should register history compatible with obesity, angina, decreased exercise tolerance, orthopnea, paroxysmal nocturnal dyspnea, syncope or presyncope, and claudication. They should prompt the clinician to obtain specific diagnostic tests according to the clinical scenario (e.g., electrocardiogram and cardiac enzymes for patients presenting with chest pain).

Besides a diagnosis, most of the efforts should be oriented for primary prevention by targeting people with the presence of risk factors and treat modifiable risk factors by all available means. All patient starting at age 20 should be engaged in the discussion of CVD risk factors and lipid measurement. Several calculators that use LDL-cholesterol and HDL-cholesterol levels and the presence of other risk factors calculate a 10-year or 30-year CVD score to determine if additional therapies like the use of statins and aspirin are indicated for primary prevention. Like other risk assessment tools, the use of this calculators have some limitations, and it is recommended to exert precaution when assessing patients with

diabetes and familial hypercholesterolemia as their risk can be underestimated. Some experts recommend a reassessment of CVD risk every 4 to 6 years.

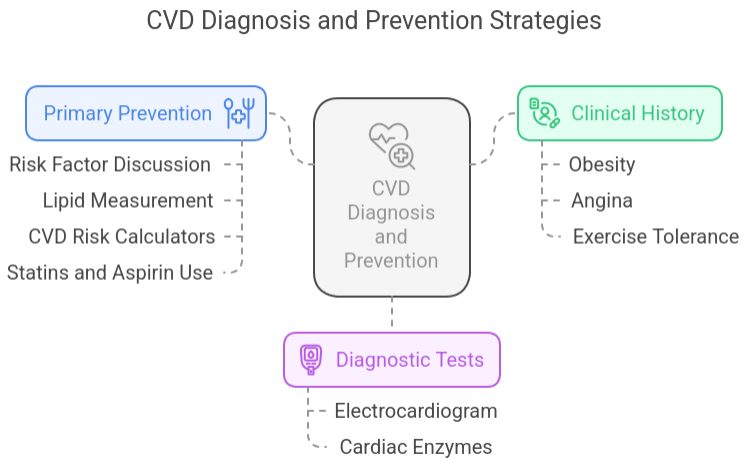

Figure 9: Primary prevention of CVD (I).

Preventive measures such as following healthy food habits, avoiding overweight, and following an active lifestyle are relevant in all patients, particularly for people with non-modifiable risk factors such as a family history of premature coronary heart disease or postmenopause.

Our aim is to identify people with known risk factors, detect people with subclinical atherosclerosis at risk for CVD, because we could then apply primary prevention: risk factor and lifestyle modification.

Efforts must be directed toward primary prevention by leading a healthy lifestyle and an appropriate diet as early as possible with the goal of delay or avoid initiation of atherosclerosis in relation to the future risk of CVD. Clinicians have developed the concept of "ideal cardiovascular health":

- Change behaviors: Non-smoking, body mass index less than 25 kg/m^2, physical activity at target levels, having a diet consistent with current guideline recommendations.
- Control risk factors: Untreated total cholesterol less than 200 mg/dL, untreated blood pressure less than 120/80 mm Hg, and fasting blood glucose less than 100 mg/dL.

Specific attention should be made to people at increased risk for CVD, as well as people with diabetes, hypertension, hyperlipidemia, smokers, and obese patients. Modifying risk factors by controlling their medical conditions, avoiding smoking, taking appropriate measures to lose weight, and maintaining an active lifestyle is of extreme importance.

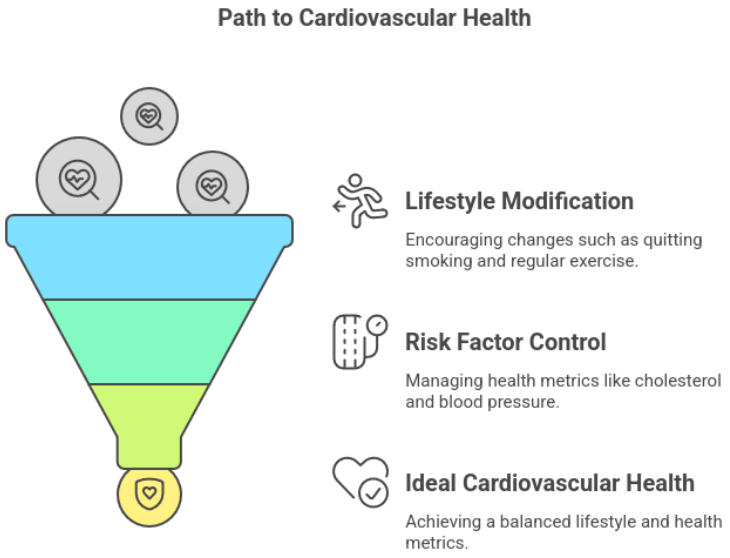

Figure 10: Prevention of CVD (II).

7 In Summary

- Cardiovascular disease generally refers to 4 general entities: CAD, CVD, PVD, and aortic atherosclerosis.
- CVD is the main cause of death globally.
- Measures aimed to prevent the progression of atherosclerosis are the hallmark for primary prevention of CVD.
- Risk factor and lifestyle modification are paramount in the prevention of CVD.

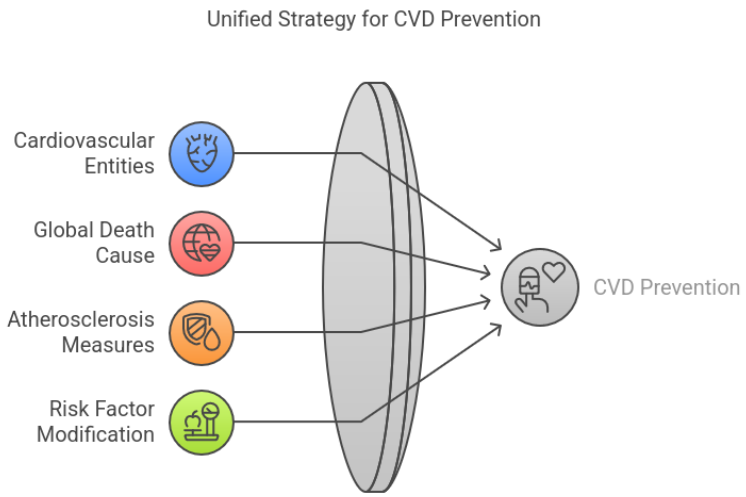

Figure 11: Prevention of CVD (III).