

Overview of Causes of Common Cardiovascular Diseases and Preventive Measures: Simple Review Article

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Abstract

Cardiovascular disease is a significant and ever-growing problem in the United Kingdom, accounting for nearly one-third of all deaths and leading to significant morbidity. It is also of particular and pressing interest as developing countries experience a change in lifestyle which introduces novel risk factors for cardiovascular disease, leading to a boom in cardiovascular disease risk throughout the developing world. The burden of cardiovascular disease can be ameliorated by careful risk reduction and, as such, primary prevention is an important priority for all developers of health policy. Strong consensus exists between international guidelines regarding the necessity of smoking cessation, weight optimisation and the importance of exercise, whilst guidelines vary slightly in their approach to hypertension and considerably regarding their approach to optimal lipid profile which remains a contentious issue. Previously fashionable ideas such as the polypill appear devoid of in-vivo efficacy, but there remain areas of future interest such as the benefit of serum urate reduction and utility of reduction of homocysteine levels. The purpose of this review has been to summarize the causes of common cardiovascular diseases and prophylactic measures.

Keywords: Cardiovascular disease, primary prevention, exercise, diet, diabetes mellitus, hypertension, smoking, alcohol.

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INTRODUCTION

Cardiovascular disease (CVD) is an umbrella term for a number of linked pathologies. The cardiovascular system consists of the heart and its blood vessels [1]. A wide array of problems can arise within the cardiovascular system, a few of which include endocarditis, rheumatic heart disease, and conduction system abnormalities. Cardiovascular disease, also known as heart disease, refers to the following 4 entities: coronary artery disease (CAD) which is also referred to as coronary heart disease (CHD), cerebrovascular disease, peripheral artery disease (PAD), and aortic atherosclerosis. CAD results from decreased myocardial perfusion that causes angina due to ischemia and can result in myocardial infarction (MI), and/or heart failure. It accounts for one-third to one-half of all cases of cardiovascular disease [2]. Cerebrovascular disease is the entity associated with strokes, also termed cerebrovascular accidents, and

transient ischemic attacks (TIAs). Peripheral arterial disease (PAD) is arterial disease predominantly involving the limbs that may result in claudication. Aortic atherosclerosis is the entity associated with thoracic and abdominal aneurysms [3].

The World Health Organization (WHO) estimate that over 75% of premature CVD is preventable and risk factor amelioration can help reduce the growing CVD burden on both individuals and healthcare providers [4]. Whilst age is a known risk factor for the development of CVD, autopsy evidence suggests that the process of developing CVD in later years is not inevitable, thus risk reduction is crucial [5].

Epidemiology of CVD:

At the beginning of the 20th century, CVD was responsible for less than 10 percent of all deaths worldwide, but by 2001 that figure was 30 percent [6].

About 80 percent of the global burden of CVD death occurs in low- and middle-income countries. predicted that CVD will be the leading cause of death and disability worldwide by 2020 mainly because it will increase in low- and middle-income countries. By 2001, CVD had become the leading cause of death in the developing world. Nearly 50 percent of all deaths in high-income countries and about 28 percent of deaths in low- and middle-income countries are the result of CVD. Other causes of death, such as injuries, respiratory infections, nutritional deficiencies, and HIV/AIDS, collectively still play a predominant role in certain regions, but even in those areas CVD is now a significant cause of mortality [7].

Causes and risk factors:

Although CVD may directly arise from different etiologies such as emboli in a patient with atrial fibrillation resulting in ischemic stroke, rheumatic fever causing valvular heart disease, among others, addressing risks factors associated to the development of atherosclerosis is most important because it is a common denominator in the pathophysiology of CVD [8].

The industrialization of the economy with a resultant shift from physically demanding to sedentary jobs, along with the current consumerism and technology-driven culture that is related to longer work hours, longer commutes, and less leisure time for recreational activities, may explain the significant and steady increase in the rates of CVD during the last few decades. Specifically, physical inactivity, 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 [2, 9].

According to the INTERHEART study that included subjects from 52 countries, including high, middle, and low-income countries, 9 modifiable risks factors accounted for 90% of the risk of having a first MI: smoking, dyslipidemia, hypertension, diabetes, abdominal obesity, psychosocial factors, consumption of fruits and vegetables, regular alcohol consumption, and physical inactivity. It is important to mention that in this study 36% of the population-attributable risk of MI was accounted to smoking [10].

Biochemical and physiological risk factors

1. Hypertension

Many risk factors are contributed to the development of CVD. Among all the risk factors for CVD, the major cause of leading CVD is hypertension. Hypertension can independently contribute to the risk of cardiovascular events, but its impact is high with associated risk factors [11]. From Framingham Heart Study displays, about 17% of women and 19% of men with hypertension had this as

their only CVD risk factor, while 32% of women and 30% of men with this hypertension had 3 or more additional risk factors.

Hypertensive heart disease results from chronic high blood pressure. Current 2017 American Cardiology Association/American Heart Association guidelines define hypertension as blood pressure as systolic blood pressure higher than 120 mm Hg or a diastolic pressure more than 80mm Hg. The risk of cardiovascular mortality doubles for every 20mmHg systolic and 10mmHg diastolic pressure increase over a baseline blood pressure of 115/75 [12].

The vast majority (90 to 95%) of hypertensive patients will classify as having primary or essential hypertension. The etiology behind primary hypertension is poorly understood. However, it likely is a complex interplay between genetic and environmental factors. Several risk factors such as increasing age, family history, obesity, high sodium diets (greater than 3g/day), physical inactivity, and excessive alcohol consumption have strong and independent correlations with the development of hypertension. Hypertension has been found to precede the development of heart failure by an average of 14.1 years [13].

Hypertensive heart disease is responsible for roughly one-fourth of all causes of heart failure. According to the Framingham Heart Study, hypertension has a 2-fold increase in the development of heart failure in men and a 3-fold increase for women when adjusted for specific risk factors and age. The 2015 SPRINT trial demonstrated a reduced risk of progression to heart failure in patients with more intensive blood pressure control with a target systolic blood pressure of 120mmHg (1.3%) compared with 140mmHg (2.1%). Proper management of hypertension correlates with a 64% reduction in the development of heart failure [14].

2. Dyslipidemia

Dyslipidemia may be defined as increased levels of serum total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), triglycerides (TG), or a decreased serum high-density lipoprotein cholesterol (HDL-C) concentration. Dyslipidemia is an established risk factor for cardiovascular disease (CVD). The prevalence of dyslipidemia varies geographically; although, it has been estimated that more than 50% of the adult population has dyslipidemia worldwide. People with dyslipidemia are two-times escalated risk of CVD as compared to those with normal lipid levels [15].

Dyslipidemia causes atherosclerosis, the clinical presentations of atherosclerotic disease are the result of a constellation of diverse metabolic and immunologic mechanisms ultimately set into motion by the formation of fatty acid streaks and the

accompanying inflammatory cell activation, endothelial damage, smooth muscle proliferation, vascular fibrosis, and end-organ infarction and necrosis [16]. At the heart of atherosclerosis are the byproducts of lipid metabolism, lipoproteins containing triglycerides, phospholipids, and cholesterol, and the changes they undergo that eventually lead to macrophage activation, foam cell formation, and other downstream atherosclerotic changes. A high-fat and high-calorie diet can cause dyslipidemia and thereafter endothelial dysfunction [17].

3. Overweight body mass and obesity

Obesity is becoming a global epidemic, and in the past 10 years in the United States, dramatic increases in obesity have occurred in both children and adults. BMI (weight in kilograms/height² in meters) is frequently used as a surrogate measure of fatness in children and adults. In adults, overweight is defined as a BMI of 25.0 to 29.9 kg/m²; obesity is defined as a BMI \geq 30.0 kg/m² [18]. Over the past 2 decades, an explosive increase in the number of people with the metabolic syndrome (MetS) has taken place all around the globe. The MetS is associated with an increased risk of both diabetes and CVD. Both overweight and obesity represent significant risk factors for CVD. The AHA lists obesity as a major risk factor for CVD not only because of its association with other risk factors (e.g., diabetes, dyslipidemias, elevated blood pressure, metabolic syndrome) but also because it serves as an independent risk factor [19]. Distribution of body fat also carries an additional risk since abdominal obesity is an independent risk factor for CHD. The accumulation of intra-abdominal fat promotes insulin resistance, which can lead to glucose intolerance, elevated triglycerides, and low HDL as well as hypertension. After a follow-up of 31.5 years, with those with a BMI between the 25th and 75th percentiles used as control subjects, it was reported that a BMI above the 95th percentile in adolescence predicted adult mortality rates in both male (80% increment) and female (\approx 100% increment) patients [20]. A 30% increase in all-cause mortality was also seen in female and male subjects when baseline BMI was between the 85th and 95th percentiles. Obesity may affect the heart through its influence on known risk factors such as dyslipidemia, hypertension, glucose intolerance, inflammatory markers, obstructive sleep apnea/hypoventilation, and the prothrombotic state, in addition to as-yet-unrecognized mechanisms [21]. On the whole, overweight and obesity predispose to or are associated with numerous cardiac complications such as coronary heart disease, heart failure, and sudden death because of their impact on the cardiovascular system.

4. Diabetes

Diabetes is a group of metabolic diseases characterized by elevated levels of glucose in the blood resulting from a defect in insulin secretion or action. Diabetes mellitus (DM) often coexists with

cardiovascular disease (CVD) in clinical practice, but the pathophysiology of this comorbid condition could be rather confusing as the amount of scientific evidence is dispersed and has increased, especially in the last decade. The strong link between these two diseases is evident. Patients with CVD share similar risk factors for DM onset such as unhealthy dietary and lifestyle habits, obesity, smoking, etc [22]. The mechanisms of the pathogenesis of CVD in diabetes are related to epigenetic, genetic, and cell-signaling defects in inter-related metabolic and inflammatory pathways. These metabolic defects (especially in the endothelium, liver, skeletal muscle, and β cells) can be triggered by various environmental factors such as high caloric intake, smoking, glycation end-products, glucose toxicity, and some medications. It could be stated that the expression of both type 2 diabetes mellitus (T2DM) and CVDs is an idiosyncratic response to the environment, guided by the biological capacity of cellular systems in patients [23].

5. Smoking

Smoking is a major cause of cardiovascular disease (CVD) and causes approximately one of every four deaths from CVD, according to the 2014 Surgeon General's Report on smoking and health. Even people who smoke fewer than five cigarettes a day may show signs of early CVD. The risk of CVD increases with the number of cigarettes smoked per day, and when smoking continues for many years [24].

Smoking cigarettes with lower levels of tar or nicotine does not reduce the risk for cardiovascular disease. Exposure to secondhand smoke causes heart disease in nonsmokers. More than 33,000 nonsmokers die every year in the United States from coronary heart disease caused by exposure to secondhand smoke. Exposure to secondhand smoke can also cause heart attacks and strokes in nonsmokers [25].

Smoking increases the formation of plaque in blood vessels. Coronary Heart Disease occurs when arteries that carry blood to the heart muscle are narrowed by plaque or blocked by clots. Chemicals in cigarette smoke cause the blood to thicken and form clots inside veins and arteries [26].

6. Alcohol consumption

Alcohol use has complex effects on cardiovascular (CV) health. Excessive alcohol intake is associated with an elevated risk of alcoholic liver disease (ALD), heart failure, some cancers, and accidental injury, and is a leading cause of preventable death in industrialized countries [27]. Some studies have suggested that one drink per day may have cardiovascular benefits. However, these studies are controversial, and the common view is that no level of alcohol consumption improves health. There is far more evidence for the harmful effects of alcohol than for any beneficial effects. It is also recognized that the alcohol

industry may promote the unsubstantiated benefits of moderate drinking [28].

Preventive measures of cardiovascular diseases [29-32]:

Up to 90% of cardiovascular disease may be preventable if established risk factors are avoided [29]. Currently practiced measures to prevent cardiovascular disease include:

- Maintaining a healthy diet, such as the Mediterranean diet, a vegetarian, vegan or another plant-based diet.
- Replacing saturated fat with healthier choices: Clinical trials show that replacing saturated fat with polyunsaturated vegetable oil reduced CVD by 30%. Prospective observational studies show that in many populations lower intake of saturated fat coupled with higher intake of polyunsaturated and monounsaturated fat is associated with lower rates of CVD [30].
- Decrease body fat if overweight or obese. The effect of weight loss is often difficult to distinguish from dietary change, and evidence on weight reducing diets is limited. In observational studies of people with severe obesity, weight loss following bariatric surgery is associated with a 46% reduction in cardiovascular risk [31].
- Limit alcohol consumption to the recommended daily limits or better is to be avoided
- Decrease non-HDL cholesterol. Statin treatment reduces cardiovascular mortality by about 31%.
- Stopping smoking and avoidance of second-hand smoke. Stopping smoking reduces risk by about 35%.
- At least 150 minutes (2 hours and 30 minutes) of moderate exercise per week.
- Lower blood pressure, if elevated. A 10 mmHg reduction in blood pressure reduces risk by about 20%. Lowering blood pressure appears to be effective even at normal blood pressure ranges [32].
- Decrease psychosocial stress. Severe emotional and physical stress leads to a form of heart dysfunction known as Takotsubo syndrome in some people. Stress, however, plays a relatively minor role in hypertension. Specific relaxation therapies are of unclear benefit.
- Not enough sleep also raises the risk of high blood pressure. Adults need about 7–9 hours of sleep. Sleep apnea is also a major risk as it causes breathing to stop briefly, which can put stress on the body which can raise the risk of heart disease.

CONCLUSION

Daily habits and actions profoundly affect the likelihood of developing CVD. Increased physical activity, proper nutrition, weight management, avoidance of tobacco, and stress reduction are all key modalities that both lower the risk of CVD and enhance quality of life.

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