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PART 6 Disorders of the Cardiovascular System Ischemic Heart Disease Robert P. Giugliano, Elliott M. Antman, Joseph Loscalzo

Ischemic heart disease (IHD) is a condition in which there is an inad equate supply of blood and oxygen to a portion of the myocardium; it typically occurs when there is an imbalance between myocardial oxygen supply and demand. The most common cause of myocardial ischemia is atherosclerotic disease of an epicardial coronary artery (or arteries) sufficient to cause a regional reduction in myocardial blood flow and inadequate perfusion of the myocardium supplied by the involved coronary artery. This chapter focuses on the chronic manifestations and treatment of IHD (sometimes referred to as chronic coronary disease or chronic coronary syndrome), while the subsequent chapters address the acute phases of IHD. ■ ■EPIDEMIOLOGY AND GLOBAL TRENDS IHD causes more deaths and disability and incurs greater economic costs than any other illness in the developed world. IHD is the most common, serious, chronic, life-threatening illness in the United States, where 20.5 million persons have IHD. Although there is regional variation, ~3–4% of the population has sustained a myocardial infarc tion. Genetic factors, a high-fat and energy-rich diet, smoking, and a sedentary lifestyle are associated with the emergence of IHD. In the United States and Western Europe, IHD is growing among low-income groups, but primary prevention has delayed the disease to later in life across socioeconomic groups. Despite these sobering statistics, it is worth noting that epidemiologic data show a decline in the rate of deaths due to IHD, about half of which is attributable to treatments and half to prevention by risk factor modification. Obesity, insulin resistance, and type 2 diabetes mellitus are increas ing and are powerful risk factors for IHD. These trends are occurring in the general context of population growth and as a result of the increase in the average age of the world’s population. With urbanization in countries with emerging economies and a growing middle class, ele ments of the energy-rich Western diet are being adopted. As a result, the prevalence of risk factors for IHD and the prevalence of IHD itself are both increasing rapidly, so that in analyses of the global burden of disease, there is a shift

from communicable to noncommunicable diseases, and it is estimated that globally over 200 million people live with IHD. Population subgroups that appear to be particularly affected are men in South Asian countries, especially India and the Middle East. IHD is a major contributor to the number of disability-adjusted lifeyears (DALYs) experienced globally. ■ ■PATHOPHYSIOLOGY Central to an understanding of the pathophysiology of myocardial ischemia is the concept of myocardial supply and demand. In normal conditions, for any given level of a demand for oxygen, the myocar dium will control the supply of oxygen-rich blood to prevent under perfusion of myocytes and the subsequent development of ischemia and infarction. The major determinants of myocardial oxygen demand (MVO2) are heart rate, myocardial contractility, and myocardial wall tension (stress). An adequate supply of oxygen to the myocardium requires a satisfactory level of oxygen-carrying capacity of the blood (determined by the inspired level of oxygen, pulmonary function, and hemoglobin concentration and function) and an adequate level of coronary blood flow. Blood flows through the coronary arteries in a phasic fashion, with the majority occurring during diastole. About 75% of the total coronary resistance to flow occurs across three sets of arteries: (1) large epicardial arteries (Resistance 1 = R1), (2) prear teriolar vessels (R2), and (3) arteriolar and intramyocardial capillary vessels (R3). In the absence of significant flow-limiting atheroscle rotic obstructions, R1 is trivial; the major determinant of coronary resistance is found in R2 and R3 (Fig. 284-1). The normal coronary circulation is dominated and controlled by the heart’s requirements for oxygen. This need is met by the ability of the coronary vascular bed to vary its resistance (and, therefore, blood flow) considerably while the myocardium extracts a high and relatively fixed percentage of oxygen. Normally, intramyocardial resistance vessels demonstrate a great capacity for dilation (R2 and R3 decrease). The changing oxygen needs of the heart with exercise and emotional stress affect coronary Section 5 Coronary and Peripheral Vascular Disease Segment and size Macrocirculation Microcirculation Main stimulus for vasomotion Metabolites Pressure Flow Exchange Regulation Transport Main function Percentage of total resistance to flow Epicardial arteries >400 µm Small arteries <400 µm Arterioles <100 µm Capillaries <10 µm FIGURE 284-1 Macrocirculation and microcirculation across segments and sizes of the arteries. The location and size of the arteries supplying blood to the heart is shown at the top. Vasomotion of the arterial segments occurs in response to the stimuli shown. The main function of each of the arterial segments is shown next, followed by a depiction of the relative resistance to antegrade flow. (Adapted from J Knuuti et al: 2019 ESC guidelines for the diagnosis and management of chronic coronary syndromes. Eur Heart J 41:407, 2020/.)

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