particularly during times of increased metabolic demand. Cardiac dysfunction may predominantly affect the left ventricle, as with a large MI, or the right ventricle, as with an acute pulmonary embolus. However, in many disease states, both ventricles are impaired (i.e., biventricular HF).

Acute HF usually refers to the situation in which an individual who was previously asymptomatic develops HF signs or symptoms after an acute injury to the heart, such as MI, myocarditis, or acute valvular regurgitation. Chronic HF refers to situations in which symptoms have developed over a long period, most often in the setting of preexisting cardiac disease. However, a patient with myocardial dysfunction from any cause may remain compensated for extended periods and then develop acute HF symptoms in the setting of arrhythmia, anemia, hypertension, ischemia, systemic illness, dietary or medication noncompliance, and progression of chronic HF.

The severity of HF symptoms does not correlate closely with the usual clinical measures of cardiac function, although the LVEF is a reasonable prognostic marker. This situation likely reflects the fact that ventricular filling pressures are a more important determinant of symptoms than myocardial function. The predisposing conditions for HF (e.g., hypertension, advanced age, coronary artery disease, renal dysfunction) are similar, and the prognosis is similar whether the LVEF is preserved or reduced. Despite many similarities, medical treatments that have proved beneficial in HF with reduced EF have not shown similar efficacy in HF with preserved ejection fraction.

HEART FAILURE WITH PRESERVED EJECTION FRACTION

Slowed relaxation of the left ventricle and increased chamber stiffness impairs ventricular filling and may contribute to elevated left ventricular (LV), left atrial, and pulmonary venous pressures. Some patients with a diagnosis of HF have normal or almost normal EFs. These patients are diagnosed with HFpEF, which is the preferred terminology for describing this condition. Relaxation abnormalities occur in most people older than 65 years and are almost universal after age 75 years; however, most of these individuals do not have HF. Isolated abnormalities of LV relaxation are insufficient to directly cause HF in the absence of other predisposing conditions. In patients with a variety of cardiovascular diseases, relaxation abnormalities appear at earlier ages than otherwise expected. No therapeutic agents that specifically target impaired relaxation have been developed. The use of diuretics to manage volume overload and the vigorous treatment of hypertension with evidence-based therapy, including angiotensin-converting enzyme (ACE) inhibitors, are the mainstay of pharmacotherapy for this condition.

Epidemiology

Prevalence

The lifetime risk of developing HF is 20%, or 1 in 5 Americans 40 years of age or older. HF affects almost 7 million Americans, and the incidence of HF has largely remained stable in the United States, with approximately 670,000 new HF cases diagnosed annually (Fig. 5-2). As patients continue to live longer, it is expected that the incidence of HF will continue to rise.

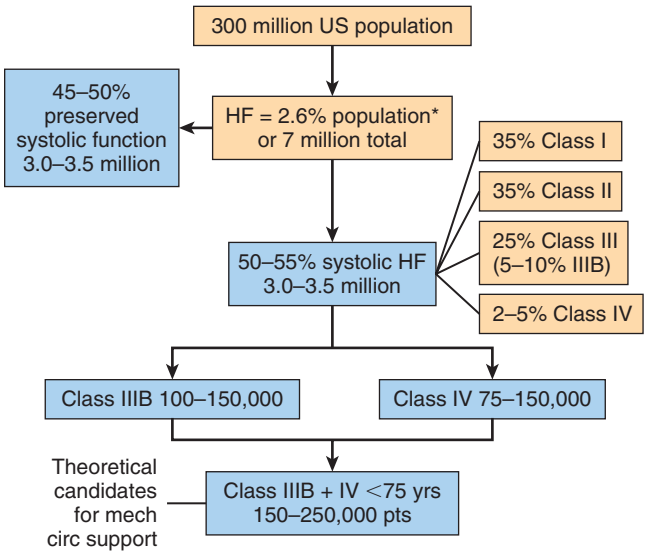

FIGURE 5-2 The lifetime risk of developing heart failure (HF) is 20%, or 1 in 5 for Americans 40 years of age or older. As patients continue to live longer, it is expected that the incidence of HF will continue to rise. HF affects almost 7 million Americans, and the incidence of HF has largely remained stable in the United States, with approximately 670,000 new HF cases diagnosed annually.

Incidence

The rate of HF increases with age, rising from 20 per 1000 people 65 to 69 years of age to more than 80 per 1000 people older than 85 years. African Americans have higher incidence and 5-year mortality rates compared with non-Hispanic whites. Despite advances in medical therapy, the mortality rate for HF remains 50% at 5 years after diagnosis.

Risk Factors

Risk factors for the development of HF include increasing age, gender (males > females), race (black > white), coronary artery disease (the cause of 60% to 75% of symptomatic HF in developed countries), hypertension, LV hypertrophy, diabetes mellitus, and obesity.

Pathogenesis

Numerous cardiac diseases can lead to HFrEF (see Table 5-1). Adaptive mechanisms maintain cardiac output and blood flow to vital organs. They include compensatory increases in ventricular volume and pressure achieved through the Frank-Starling mechanism and neurohormonal activation. Left untreated, these adaptive responses ultimately are detrimental and result in sodium and fluid retention, which worsen ventricular remodeling and further deteriorate systolic function (Fig. 5-3).

Normally, increasing either the stroke volume or the heart rate can augment cardiac output. Stroke volume depends on the contractility of the myocardium, LV filling (i.e., preload), and resistance to LV emptying (i.e., afterload). According to the Frank-Starling law, stroke volume can be increased with minimal elevation in LV pressure as long as contractility is normal.

When there is depressed contractility (Fig. 5-4A), the end-diastolic volume is increased in an attempt to maintain stroke volume. However, when the LV end-diastolic pressure approaches 20 to 25 mm Hg, pulmonary edema may develop due to