hypertensive hypertrophy or unexplained increased cardiac mass as the only finding.

- Other miscellaneous causes, such as pericardial tamponade, pulmonary embolism, systemic metabolic and hemodynamic alterations, catecholamines, and drugs of abuse, particularly cocaine and methamphetamine.

The mechanism of SCD is most often a lethal arrhythmia (e.g., asystole or ventricular fibrillation). Notably, infarction need not occur; 80% to 90% of patients who suffer SCD but are successfully resuscitated do not show any enzymatic or ECG evidence of myocardial necrosis—even when the original cause was ischemic heart disease. Although ischemic injury (and other pathologies) can directly affect the major components of the conduction system, most cases of fatal arrhythmia are triggered by electrical irritability of myocardium distant from the major elements of the conduction system.

The prognosis of patients vulnerable to SCD is markedly improved by pharmaceutical intervention, and particularly by implantation of automatic cardioverter defibrillators that can sense and electrically counteract episodes of ventricular fibrillation.

MORPHOLOGY

Marked coronary atherosclerosis with a critical (>75% cross-sectional area) stenosis involving one or more of the three major vessels is present in 80% to 90% of SCD victims; only 10% to 20% of cases are of nonatherosclerotic origin. Usually there are high-grade stenoses (>90% of area); in approximately one half, acute plaque disruption is observed, and in approximately 25% diagnostic changes of acute MI are seen. This suggests that many patients who die suddenly are suffering an MI, but the short interval from onset to death precludes the development of diagnostic myocardial changes. However, in one study of those who had been successfully resuscitated from a sudden cardiac arrest, a new MI occurred in only 39% of the patients. Thus, most SCD is not associated with acute MI; most of these deaths are thought to result from myocardial ischemia-induced irritability that initiates malignant ventricular arrhythmias. Scars of previous infarcts and subendocardial myocyte vacuolization indicative of severe chronic ischemia are common in such patients.

KEY CONCEPTS

Arrhythmias

- Arrhythmias can be caused by ischemic or structural changes in the conduction system or by intrinsic myocyte electrical instability. In structurally normal hearts, arrhythmias are more often due to mutations in ion channels that cause aberrant repolarization or depolarization.
- SCD typically results from ventricular fibrillation, and is most frequently a consequence of coronary artery disease. Myocardial irritability typically results from nonlethal ischemia or from preexisting fibrosis from previous myocardial injury. SCD is less often due to acute plaque rupture with thrombosis that induces a rapidly fatal arrhythmia.

Hypertensive Heart Disease

Hypertensive heart disease (HHD) is a consequence of the increased demands placed on the heart by hypertension, causing pressure overload and ventricular hypertrophy. Although most commonly seen in the left heart as the result of systemic hypertension, pulmonary hypertension can cause right-sided HHD, or *cor pulmonale*.

Systemic (Left-Sided) Hypertensive Heart Disease

Hypertrophy of the heart is an adaptive response to the pressure overload of chronic hypertension. However, such compensatory changes may be ultimately maladaptive and can lead to myocardial dysfunction, cardiac dilation, CHF, and in some cases sudden death. *The minimal pathologic criteria for the diagnosis of systemic HHD are the following: (1) left ventricular hypertrophy (usually concentric) in the absence of other cardiovascular pathology and (2) a clinical history or pathologic evidence of hypertension in other organs (e.g., kidney).* The Framingham Study established unequivocally that even mild hypertension (levels only slightly above 140/90 mm Hg)—if sufficiently prolonged—induces left ventricular hypertrophy. Approximately 30% of the population of the United States suffers from hypertension of at least this degree. The pathogenesis of hypertension is discussed in Chapter 11.

MORPHOLOGY

Hypertension induces left ventricular pressure overload hypertrophy, initially without ventricular dilation. As a result, the left ventricular wall thickening increases the weight of the heart disproportionately to the increase in overall cardiac size (Fig. 12-20*A*). The thickness of the left ventricular wall may exceed 2.0 cm, and the heart weight may exceed 500 gm. In time the increased thickness of the left ventricular wall, often associated with increased interstitial connective tissue, imparts a stiffness that impairs diastolic filling, frequently with consequent left atrial enlargement.

Microscopically, the earliest change of systemic HHD is an increase in the transverse diameter of myocytes, which may be difficult to appreciate on routine microscopy. At a more advanced stage variable degrees of cellular and nuclear enlargement become apparent, often accompanied by interstitial fibrosis.

Compensated systemic HHD may be asymptomatic, producing only electrocardiographic or echocardiographic evidence of left ventricular enlargement. In many patients, systemic HHD comes to attention due to new atrial fibrillation induced by left atrial enlargement, or by progressive CHF. Depending on the severity, duration, and underlying basis of the hypertension, and on the adequacy of therapeutic control, the patient may (1) enjoy normal longevity and die of unrelated causes, (2) develop IHD due to both the potentiating effects of hypertension on coronary atherosclerosis and the ischemia induced by increased oxygen demand from the hypertrophic muscle, (3) suffer renal damage or cerebrovascular stroke as direct effects of