

Acute cor pulmonale due to pulmonary thromboembolism ([Chap. 279](#)), for example, may be associated with a normal ECG or a variety of abnormalities. Sinus tachycardia is the most common arrhythmia, although other tachyarrhythmias, such as atrial fibrillation or flutter, may occur. The QRS axis may shift to the right, sometimes in concert with the so-called $S_1Q_3T_3$ pattern (prominence of the S wave in lead I and the Q wave in lead III, with T-wave inversion in lead III). Acute right ventricular dilation also may be associated with slow R-wave progression and ST-T abnormalities in V_1 to V_4 simulating acute anterior infarction. A right ventricular conduction disturbance may appear.

Chronic cor pulmonale due to obstructive lung disease ([Chap. 296](#)) usually does not produce the classic ECG patterns of right ventricular hypertrophy noted above. Instead of tall right precordial R waves, chronic obstructive lung disease (emphysema) more typically is associated with small R waves in right to mid-precordial leads (slow R-wave progression) due in part to downward displacement of the diaphragm and the heart. Low-voltage complexes are commonly present, owing to hyperaeration.

Multiple voltage criteria for *left ventricular hypertrophy* ([Fig. 240-9](#)) have been proposed on the basis of the presence of tall left precordial R waves and deep right precordial S waves (e.g., $SV_1 + [RV_5 \text{ or } RV_6] > 35 \text{ mm}$). Repolarization abnormalities (ST depression with T-wave inversions, formerly called the left ventricular “strain” pattern) also may appear in leads with prominent R waves. However, prominent precordial voltages may occur as a normal variant, especially in athletic or young individuals. Left ventricular hypertrophy may increase limb lead voltage with or without increased precordial voltage (e.g., $RaVL + SV_3 > 20 \text{ mm}$ in women and $> 28 \text{ mm}$ in men). The presence of left atrial abnormality increases the likelihood of underlying left ventricular hypertrophy in cases with borderline voltage criteria. Left ventricular hypertrophy often progresses to incomplete or complete left bundle branch block. The sensitivities of conventional voltage criteria for left ventricular hypertrophy are low in middle-age to older adults and may be decreased further in obese persons and smokers, as well as with