

short QT syndrome and its relationship to sudden cardiac arrest are discussed in [Chap. 255](#).

The ECG is usually recorded on graph paper divided into 1-mm² gridlike boxes. When the recording speed is 25 mm/s, the smallest (1 mm) horizontal divisions correspond to 40 ms (0.04 s), with heavier lines at intervals of 200 ms (0.20 s). Vertically, the ECG graph measures the amplitude of a specific wave or deflection (1 mV = 10 mm with standard calibration; the voltage criteria for hypertrophy mentioned below are given in millimeters). There are four major sets of ECG intervals: RR, PR, QRS, and QT/QT_c ([Fig. 240-2](#)). The instantaneous heart rate (beats per minute) can be computed from the interbeat (RR) interval by dividing the number of large (0.20 s) time units between consecutive R waves into 300 or the number of small (40 ms) segments into 1500. The PR interval measures the time (normally 120–200 ms) between atrial and ventricular depolarization, which includes the physiologic delay imposed by stimulation of cells in the AV junction area. The QRS interval (normally 100–110 ms or less) reflects the duration of ventricular depolarization. The QT interval subtends both ventricular depolarization and (primarily) repolarization times and varies inversely with the heart rate. A variety of formulas have been proposed for computing a rate-corrected QT, termed QT_c, but without formal consensus. The classic “square root” formula ($QT_c = QT/\sqrt{RR}$, computed in second units) has been criticized for systematic errors at both lower and higher heart rates. One alternative is the Framingham formula (given here for units of milliseconds): $QT_c = QT + 0.154 (1000 - RR)$. The following upper normal limits (based on longest QT) have been proposed: QT_c of 460 ms in women and 450 ms in men. Lower limits are less well defined. QT/QT_c measurements, both visual and electronic, should be assessed in light of inherent limitations in their precise determination from standard ECGs waveforms.

■ ECG LEADS

The 12 conventional ECG leads are divided into two groups: six limb (extremity) leads and six chest (precordial) leads. The limb leads