



**Figure 11.26** Volume changes in the left ventricle and pressure changes in the left atrium, the left ventricle, and the aorta during different phases of the heart cycle. ECG, heart sounds, and opening and closing of the bicuspid valve are also shown.

decrease rapidly. Diastole starts when the ventricular pressures become lower than the atrial pressures. The pressure difference between the atria and the ventricles then opens the AV valves and blood flows into the relaxed ventricles. Because blood has accumulated in the atria during systole, the ventricles fill rapidly during the first third of the diastole (Fig. 11.26, phase 1). During the middle third of the diastole, small amounts of blood flow directly from the venous side, through the atria, and into the ventricles. During the final third part of the diastole, the atrial muscle contracts (Fig. 11.26, phase 2). However, only 20–30 % of the ventricular filling occurs during this phase. Normal atrial function is thus not absolutely necessary for the pumping ability of the ventricles, which explains why atrial fibrillation does not have a catastrophic impact on the pumping function of the heart. However, the maximum pumping ability of the heart is reduced by 20–30 % if the pumping function of the atria fails, and such a reduction has a strong negative impact during strenuous exercise.

During diastole, the aortic valve is closed because the pressure in the aorta is higher than in the left ventricle. Because the aorta propels blood to the venous side without receiving any from the ventricle, aortic pressure falls during the diastolic phase.

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**55** Define the terms systole and diastole.

**56** Describe how the cardiac valves open and close.

**57** How much of the ventricular filling is due to contraction of the atria?

Ventricular filling starts when pressure falls below atrial pressures

Only 20–30 % of ventricular filling occurs during atrial contraction

contractions and relaxations of the atria. Atrial contraction occurs at the end of the diastolic phase, when the ventricles are relaxed. When the ventricles contract during systole, the atria are relaxed.

**Diastole: the ventricles fill with blood.** When the ventricles relax, the pressures within them

**Systole: the ventricles contract.** Ventricular contraction (systole) starts immediately after the Q wave of the QRS complex (Fig. 11.26). When the ventricles contract, the ventricular pressures