



FIGURE 11-2 Diagram of a standard cardiopulmonary bypass circuit. See text for details. (Cohn LH: Cardiac surgery in the adult, ed 4, New York, 2011, McGraw-Hill.)

synchronized with the ECG or arterial waveform of the patient to fill during diastole and deflate during systole. Balloon inflation during diastole increases aortic pressure, referred to as diastolic augmentation, allowing for maximal delivery of oxygenated blood to the coronary arteries. Deflation during systole decreases the afterload and oxygen consumption of the heart while improving cardiac output. Potential major complications include balloon leak, severe bleeding (e.g., retroperitoneal), major limb ischemia, and death.

Ventricular Assist Devices

VAD was first successfully applied in 1966 by Michael E. DeBakey for cardiogenic shock after cardiac surgery in a 37 year-old female patient. She was maintained on the device for 10 days before being discharged home. The early cardiac assist devices were developed to improve weaning off the CPB machine in cardiac surgery patients. Today, distinct VADs have been designed for short-term and long-term management of failure of the right, left, or both ventricles.

Although cardiac transplantation remains the standard of care for refractory heart failure, the number of available donor hearts has plateaued, limiting the number of heart transplantations performed in the United States to just 2000 per year. Between 15% to 25% of patients with end-stage heart failure die while awaiting transplantation. As a result, the use of VADs, in particular LVADs, has significantly increased over the last 2 decades. As discussed later, LVADs have demonstrated a viable alternative for patients awaiting transplantation and for those who do not meet heart transplant criteria. This technology of surgical intervention has changed the dynamic and expanded management capabilities for patients with advanced heart failure. For the medical management of heart failure, refer to [Chapter 60](#).

Compared with optimal medical therapy, LVADs have demonstrated improved 1- and 2-year survival rates in patients with end-stage heart failure, when compared to optimal medical therapy. The use of LVADs continues to evolve as clinical insights of the consequences of current devices are recognized and newer devices become available. Few randomized clinical trials exist,