

vessels.

In the alveoli, the surface tension of the fluid is reduced by **surfactant**, a substance produced by the alveolar epithelium that coats the alveolar surface. The effect of surfactant in facilitating breathing is discussed in relation to respiratory distress syndrome (see [Chapter 8](#)).

Circulatory System

As important as the initiation of respiration are the circulatory changes that allow blood to flow through the lungs. These changes, which occur more gradually, are the result of pressure changes in the lungs, heart, and major vessels. The transition from fetal to postnatal circulation involves the functional closure of the **fetal shunts**: the foramen ovale, the ductus arteriosus, and eventually the ductus venosus. (For a review of fetal circulation, see [Chapter 23](#).) Increased blood flow dilates the pulmonary vessels, pulmonary vascular resistance decreases, and systemic resistance increases, thus maintaining blood pressure (BP). As the pulmonary vessels receive blood, the pressure in the right atrium, right ventricle, and pulmonary arteries decreases. Left atrial pressure increases above right atrial pressure, with subsequent foramen ovale closure. With the increase in pulmonary blood flow and dramatic reduction of pulmonary vascular resistance, the ductus arteriosus begins to close.

The most important factors controlling ductal closure are the increased oxygen concentration of the blood and the fall in endogenous prostaglandins. The foramen ovale closes functionally at or soon after birth. The ductus arteriosus is closed functionally by the fourth day. Anatomic closure takes considerably longer. Failure of the ductus arteriosus or foramen ovale to close results in persistence of fetal shunting of blood away from the lungs (see [Chapter 23](#)).

Because of the reversible flow of blood through the ductus during the early neonatal period, a functional murmur occasionally may be heard. In conditions such as crying or straining, the increased pressure shunts deoxygenated blood from the right side of the heart across the ductal opening, which may cause **transient cyanosis**.