



# Lung in Health and Disease

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## INTRODUCTION

The lung is part of the respiratory system (Fig. 13-1). The respiratory system includes the centers for respiratory control in the brain cortex and medulla, the spinal cord, and peripheral nerves that innervate the skeletal muscles of respiration and the airways and vessels. The upper airway, including the nose, pharynx, and larynx, is where inspired air is humidified and particulate matter is filtered. The bony structure of the chest wall protects the heart, lungs, and liver, and the lungs are maintained in an inflated state by mechanical coupling of the chest wall with the lungs. The skeletal muscles of respiration include the diaphragm and the accessory muscles; the latter are important when disease causes diaphragm fatigue.

The lung consists of conducting airways, blood vessels, and gas exchange units with alveolar gas spaces and capillaries. The lung is a complex organ with an extensive array of airways and vessels arranged to efficiently transfer the gases necessary for sustaining life. The organ has an immense capacity for gas exchange. It is not a limiting factor in exercise tolerance in healthy individuals, but

gas exchange becomes compromised in lung disease, rendering the host unable to function properly. The most dramatic consequence of acute and chronic abnormalities in lung function is systemic hypoxemia, which causes tissue hypoxia. The sequelae of lung dysfunction include detrimental effects to other organs.

In addition to gas exchange, the lungs have other functions, such as defense against inhaled infectious agents and environmental toxins. The entire cardiac output passes through the pulmonary circulation, which serves as a filter for blood-borne clots and infections. The massive surface area of endothelial cells lining the pulmonary circulation has metabolic functions, such as conversion of angiotensin I to angiotensin II.

Lung disorders are common and range from well-known conditions such as asthma and chronic obstructive pulmonary disease (COPD) to rarely encountered disorders such as lymphangioliomyomatosis. The chapters in Section III discuss the diagnosis, evaluation, and management of pulmonary disorders that develop in direct response to lung injury and those that develop indirectly through injuries to other organs. Section III also addresses illnesses requiring critical care, such as acute lung injury and sepsis, which are often triggered by injuries to the lung and are frequently managed by pulmonary or critical care specialists.

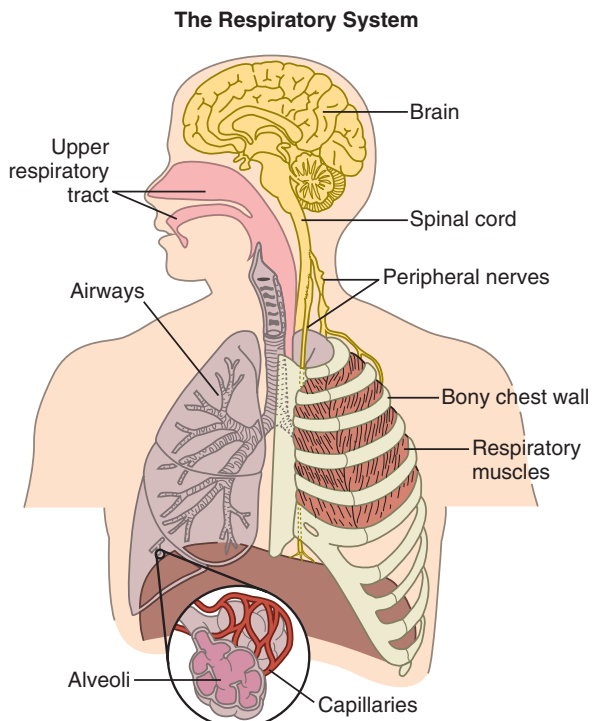
This chapter reviews the structural-functional relationships of the lung during development, the epidemiology of pulmonary disease, and the classification of pulmonary disorders.

## LUNG DEVELOPMENT

The lung begins to develop during the first trimester of pregnancy through complex and overlapping processes that transform the embryonic lung bud into a functioning organ with an extensive airway network, two complete circulatory systems, and millions of alveoli responsible for the transfer of gases to and from the body. Lung development occurs in five consecutive stages: embryonic, pseudoglandular, canalicular or vascular, saccular, and alveolar postnatal (Table 13-1).

During the embryonic stage (between 21 days and 7 weeks' gestation), the rudimentary lung emerges from the foregut as a single epithelial bud surrounded by mesenchymal tissue. This stage is followed by the pseudoglandular stage (between 5 and 17 weeks' gestation), during which repeated monochotomous and dichotomous branching forms rudimentary airways, a process called *branching morphogenesis* (Fig. 13-2). Coinciding with airway formation, new bronchial arteries arise from the aorta.

The canalicular stage (between 17 and 24 weeks' gestation) is characterized by the formation of the acinus, differentiation of



**FIGURE 13-1** The respiratory system includes neural structures that control breathing, the chest wall and skeletal muscles of breathing, the upper airway, and lung parenchyma.