CHAPTER 7

Pulmonary Diseases

Highlights

- Untreated obstructive sleep apnea is associated with coronary artery disease, congestive heart failure, arrhythmias, refractory hypertension, and type 2 diabetes mellitus. It is also strongly associated with various ocular conditions.
- Smoking cessation is the single most efficacious and cost-effective intervention in reducing the risk of COPD, heart disease, and stroke. Ophthalmologists should obtain a smoking history from their patients and encourage smoking cessation.

Introduction

The lungs can be affected by numerous pathologic processes, including inflammation (allergic, infectious, autoimmune, toxic), vascular insults, fibrosis, carcinoma, and changes resulting from cardiac or musculoskeletal problems. The functional consequences of the pathology can be divided into obstructive ventilatory functions and restrictive ventilatory functions.

Symptoms of lung disease include dyspnea, cough, and wheezing. Dyspnea develops when the demand for gas exchange exceeds the capacity of the respiratory system, as in hypoxemia or hypercapnia. Dyspnea may also reflect the increased work of breathing, as occurs in cases of airway obstruction or reduced compliance of the lungs or chest. Cough develops when mucus, inflammatory debris, or irritants stimulate the bronchi, causing reflex clearing expectoration, or when the lung parenchyma is infiltrated with fluid, cells, or fibrosis. Wheezing occurs when bronchospasm narrows the large airways and exhaled air is forced through narrowed passages.

Obstructive Lung Diseases

In patients with obstructive lung disease, changes in the bronchi, bronchioles, and lung parenchyma can cause airway obstruction. Obstructive lung diseases can be categorized as reversible or irreversible, although many cases may have some degree of both reversible and irreversible obstruction.

Reversible obstructive diseases are grouped under the term asthma. In patients with asthma, the airways are hyperresponsive and develop an inflammatory response with bronchospasm to various stimuli; the specific cause and duration of the bronchospasm can vary.
In some persons, allergic immunoglobulin E (IgE)–mediated reactions to defined antigens cause bronchospasm. In many individuals with asthma, however, the cause of abnormal airway reactivity remains unknown. Precipitating factors may include exercise, aspirin, sulfites, tartrazine dye, emotional stress, cold air, environmental pollutants, or viral infection. Bronchial smooth muscle constriction, mucosal edema, excess mucus accumulation, and epithelial cell shedding all contribute to airway obstruction. This obstruction may be reversible, either spontaneously or with treatment. One marker of eosinophilic airway inflammation is an increase in exhaled nitric oxide; identifying this increase may be important in measuring an individual’s responsiveness to therapeutic intervention. Mepolizumab, a monoclonal antibody, is approved for use in cases of severe eosinophilic asthma.

Irreversible obstructive disease (sometimes known as chronic obstructive pulmonary disease [COPD]) comprises a group of conditions in which forced expiratory flow is reduced in either a constant or a slowly progressive manner over months or years. COPD is the third leading cause of death in the United States. The Global Initiative for Chronic Obstructive Lung Disease (GOLD), an international consortium working to improve prevention and treatment of COPD, publishes a guide on the diagnosis, classification, and management of this condition. The guide, which is updated regularly, can be downloaded from the GOLD website (www.goldcopd.org). GOLD offers a framework for the management of COPD. Some conditions, such as cystic fibrosis or bronchiectasis, which are either secondary to recurrent necrotizing bacterial infections or which occur as part of Kartagener syndrome, have an identifiable cause. However, most irreversible obstructive diseases, such as emphysema, chronic bronchitis, and peripheral airway disease, cannot be ascribed to specific conditions; rather, they represent an individual response to cigarette smoking and various airborne pollutants. For example, such responses occur in patients with either α₁-antitrypsin deficiency (associated with certain forms of emphysema) or airway hyperactivity and mucus hypersecretion (as in bronchitis). The pathologic consequences of the abnormal response result in specific damage to lung tissue. Emphysema is characterized by pathologic enlargement of the terminal bronchiole air spaces and by destruction of the alveolar connective tissue septa. Bronchitis is characterized by hypertrophied mucous glands in the bronchi; in peripheral airway disease, only the small airways demonstrate fibrosis, inflammation, and obstruction.

Obstructive sleep apnea (OSA) has similar pathophysiologic processes to COPD: compromised gas exchange that leads to hypoxia and hypercapnia. OSA is a breathing disorder characterized by the narrowing of the upper airway, which impairs normal ventilation during sleep. This physical disruption of the upper airway distinguishes OSA from central sleep apnea, which occurs as a result of the brain temporarily not transmitting signals to the muscles that control breathing, leading to insufficient ventilation and compromised gas exchange. The current prevalence of OSA in the United States is estimated at 14% for men and 5% for women. The prevalence of OSA is much higher in patients with coronary artery disease, congestive heart failure, arrhythmias, refractory hypertension, type 2 diabetes mellitus, and polycystic ovary disease. The fragmented sleep experienced by individuals with untreated OSA can lead to many negative consequences, including daytime sleepiness, cognitive disfunction, and decreased quality of life. Untreated OSA is also associated with an increased risk of developing cardiovascular disease, resistant hypertension, coronary