

## **Healthy Steps for Healthy Lungs**

Breathing for most of us is something we do without being aware of it. We pay no attention to this continuous activity as we work, play, or sleep. Our lungs are responsible for this essential natural function that gets oxygen into the bloodstream so that it can be delivered to the cells of our body.

During a normal day, we breathe nearly 25,000 times. The more than 10,000 liters of air we inhale is mostly oxygen and nitrogen. In addition, there are small amounts of other gases, floating bacteria, and viruses. It also contains the products of tobacco smoke, automobile exhaust, and other pollutants from the atmosphere in varying amounts.

Air pollutants can affect our lungs in many ways. They may simply cause irritation and discomfort. But sometimes inhaled materials can cause illness or death. The lungs have a series of built-in mechanical and biological barriers that keep harmful materials from entering the body. In addition, specific defense mechanisms can inactivate some disease-causing materials.

However, sometimes the normal lung defenses and barriers in the lungs do not work as well as they should. Medical problems at birth or during infancy and growth can affect lung development. Later in life the lungs may be damaged by smoking, occupational exposures, or accidents. These abnormalities allow air pollutants to break through the lung's defenses. The result can be respiratory problems or diseases.

The lungs are shaped like cones and textured like a fine grained sponge that can be inflated with air. They sit within the thoracic cage where they stretch from the trachea (windpipe) to below the heart. About 10 percent of the lung is solid tissue, the remainder is filled with air and blood.

This unique structure of the lung is delicate enough for gas exchange and yet strong enough to maintain its shape and enable it to perform the many functions vital for keeping us healthy. Two "plumbing" systems, the airways for ventilation (exchange of air between the lungs and the atmosphere) and the circulatory system for perfusion (blood flow), are coordinated by special muscles and nerves. This arrangement enables the lung to perform its primary function of rapidly exchanging oxygen from inhaled air with the carbon dioxide from the blood.

### **Lung Diseases: How They Begin**

The most common clinical signs of lung diseases are cough, chest pain, chest tightness, shortness of breath (dyspnea), and abnormal breathing patterns. When any of these symptoms appear, it may signal that some vital functions of the lung have been disturbed. Because most individuals

have enormous reserves of lung tissue, the disturbances in lung defenses or function may have begun some time before the clinical symptoms begin to appear.

Respiratory problems can have a number of causes. They usually arise from acute or chronic inhalation of toxic agents in the workplace or other settings, accidents, or harmful lifestyles such as smoking. Infections, genetic factors, or anything else that directly or indirectly affects lung development and function can also cause respiratory symptoms. In some lung diseases, the lung itself has been damaged. Others result from diseases of the nervous system or the muscles. These disorders interfere with the normal function of the respiratory muscles so that, although the lung itself is normal, breathing is difficult.

Estimates of the number of known lung diseases vary from a few dozen to several hundred. Lung diseases are classified and counted either as individual, specific diseases, or as groups of diseases that share common features. These features may be their sites, etiologies (initiating events), pathophysiology (abnormalities of function), or clinical features (signs and symptoms).

Most doctors find it convenient to deal with lung diseases in groups, based on the particular pulmonary (lung) component that is diseased. Examples are diseases of the airways, diseases of the interstitium (the space between tissues), or disorders of the pulmonary circulation, the ventilatory apparatus, or gas exchange. Often, many of these diseases occur together, particularly if they are caused by infection, inflammation, or cancer. In such cases they present an overlapping, progressive series of a mixture of clinical symptoms.

### **Diseases of the Airways**

Airways diseases are lung disorders that are primarily due to a continuing obstruction of airflow. Acute or chronic airflow obstruction or limitation can be caused by a variety of structural changes in the airways. Asthma, chronic bronchitis, emphysema, bronchiolitis, cystic fibrosis, and bronchiectasis are some common airways diseases.

The term chronic obstructive pulmonary disease (COPD) is commonly used for chronic bronchitis and emphysema that exist together in many patients and in which the airway obstruction is mostly irreversible. COPD is the fourth most common and the most rapidly increasing cause of death in the United States.

- In asthma, reversible airway obstruction is caused by inflammation, contraction of the airway smooth muscle, increased mucus secretion, and plugging of the bronchioles.
- In chronic bronchitis, airway obstruction results from chronic and excessive secretion of abnormal airway mucus, inflammation, bronchospasm, and infections.
- In emphysema, a structural element (elastin) in the terminal bronchioles is destroyed leading to collapse of the airway walls and inability to exhale “stale” air.
- Bronchiolitis in children is due to viral infections that cause obstructive inflammatory changes in the bronchioles.
- Cystic fibrosis is a genetic disease in which thickened airway mucus, pulmonary infections, and inflammation lead to bronchiectasis and airway obstruction.
- In bronchiectasis, airway obstruction is due to chronic abnormal dilation (stretching) of the bronchi and the destruction of the elastic and muscular components of the bronchial walls; it is usually caused by repeated lung infections.

### **Diseases of the Interstitium**

The interstitium (the space between tissues) of the lungs includes portions of the connective tissue of the blood vessels and air sacs. Major chronic diseases of the lower respiratory tract in which fibrosis (scarring of the lung tissue) occurs affect the interstitial tissue. Sarcoidosis and pulmonary fibrosis are examples of the more than 150 interstitial lung diseases. Another term for these diseases is “stiff lung” disease. The most common symptoms are shortness of breath after exercise and a nonproductive cough. Some patients with interstitial lung diseases have fever, fatigue, muscle and joint pain, and abnormal chest sounds. As these diseases advance, heart function is affected.

Some interstitial lung diseases are caused by occupational or environmental exposure to inorganic dusts. Workers who inhale particles of silica are at risk for silicosis; similarly, workers in beryllium mines may develop berylliosis. Interstitial lung diseases may also be caused by inhaling organic dusts such as bacteria. Lung disease that results from breathing in animal proteins is called hypersensitivity pneumonitis. Drugs, poisons, infections, and radiation have also been known to cause these diseases. However, approximately two-thirds of the cases of interstitial lung diseases have no known cause and are therefore termed “idiopathic.”

Interstitial lung diseases begin with inflammation of the lung cells. This may be caused by an immune response or injury. The lungs stiffen as a result of inflammation of the air sacs (alveolitis) and scarring (fibrosis).

### **Disorders of Gas Exchange and Blood Circulation**

*Pulmonary edema* occurs when excess fluid collects in the tissues and air spaces of the lungs. The fluid interferes with gas exchange, thus causing the patient to be short of breath and to possibly have wheezing and a persistent cough. Pulmonary edema may result from diseases of the heart or may occur as complications of other illnesses such as widespread viral or other infections, drug toxicity, exposure to high altitudes, kidney failure, or hemorrhagic shock.

*Pulmonary embolism* is the sudden blocking of the blood flow in one of the arteries in the lung. The highly branched network of blood vessels in the lung filters the blood as it flows through it. Sometimes the blood carries a blood clot, a fat globule, an air bubble, or a piece of tissue that is large enough to block a blood vessel leading to the lung’s network of capillaries. Gas exchange then can no longer occur in this section of the lung. The result is shortness of breath or even heart failure. The most common form of pulmonary embolism is a thromboembolism. It occurs when a blood clot travels from the legs or pelvis to the pulmonary blood vessels.

*Respiratory failure* is the inability of the lungs to perform gas exchange. It occurs either when the muscles of the ventilatory system fail or when the structures that perform gas exchange are unable to function. Patients with neuromuscular diseases such as muscular dystrophy and polio may have normal lungs, but they can develop respiratory failure because their disease-weakened muscles are unable to pump air into their lungs. When gas exchange is impaired, not enough oxygen gets into the blood to fuel the body’s metabolic activity. This condition is called *hypoxemia*. Chronic hypoxemia causes the blood vessels in the lung to contract; the result is

pulmonary hypertension. Hypoxemia may also weaken the heart and the circulatory system. Any lung disease, if not adequately treated, can lead to respiratory failure.

*Adult or acute respiratory distress syndrome (ARDS)* was once called “shock lung.” It is a type of pulmonary edema that is not related to heart problems. It has many causes such as severe infections, exposure to toxic fumes, circulatory collapse, sepsis (presence of disease-causing organisms or their toxic products in blood or other tissues), shock following severe blood loss, and bone fractures. During ARDS, there is severe damage to the alveolar surfaces, the blood-air barrier becomes leaky, and protein-containing fluid fills the alveoli so that they can no longer conduct gas exchange.

*Respiratory distress syndrome of the newborn (RDS)* is a type of respiratory failure that develops most commonly in premature or low birth weight babies whose lungs have not yet made enough surfactant. The surfactant is critical for opening the baby’s alveoli with its first breath and keeping them open. As the lungs collapse, respiratory distress occurs.

*Pulmonary hypertension* is a disorder in which the blood pressure in the pulmonary arteries is abnormally high. In severe pulmonary hypertension, the right side of the heart must work harder than usual to pump blood against the high pressure. When this continues for long periods, the right heart enlarges and functions poorly, and fluid collects in the ankles (edema) and the belly. Eventually the left side of the heart begins to fail. Heart failure caused by pulmonary disease is called *cor pulmonale*. The most common causes of *cor pulmonale* are various combinations of emphysema, chronic bronchitis, and/or fibrosis. When pulmonary hypertension occurs in the absence of any other disease, it is called primary pulmonary hypertension. It affects more women than men; its cause is not known.

Pulmonary hypertension that results from another disease of the heart or lungs (for example, congenital heart disease, pulmonary thromboembolism, COPD, or interstitial fibrosis) is called secondary pulmonary hypertension.

### **Lung Disorders From Unusual Atmospheric Pressure**

At high altitudes, the air pressure is less than at sea level, and the air contains less oxygen. Some individuals traveling to high altitudes experience a variety of symptoms while they adapt to changes in the atmosphere. The symptoms are probably due to excess fluid accumulation in the tissues.

- Acute mountain sickness causes dizziness, headache, and drowsiness; lethargy, shortness of breath, and nausea and vomiting may also occur.
- High altitude cerebral edema (fluid in brain tissue) is diagnosed when a person has symptoms of severe headache, confusion, nausea, and vomiting. Seizures may occur that can lead to coma and even death.
- High altitude pulmonary edema (fluid in the lung tissue) may cause cough and shortness of breath on exercise or, when severe, progressive shortness of breath even at rest, suffocation, and death.

When people dive into deep water below sea level, they become exposed to increased atmospheric pressures. This causes greater than normal amounts of nitrogen to become dissolved

in their blood. If the diver returns too quickly to the surface, the excess nitrogen leaves the blood in the form of bubbles that lodge in the blood vessels of vital organs, causing necrosis (cell death) in surrounding tissue. Although this condition (decompression sickness) typically involves the limbs near a joint and is known as the bends, it can also occur in the chest, lung, or brain.

### **Disorders of the Pleura**

Pleural effusion means an accumulation of fluid in the pleural space. It may result from heart failure, cancer, pulmonary embolism, or inflammation. If the pleurae themselves are inflamed, the condition is called pleurisy. Pleurisy causes severe chest pain with every breath and may occur with pleural effusion. If blood is the accumulating fluid, the condition is referred to as hemothorax. If the accumulating liquid is pus, it is called empyema.

When air accumulates in the pleural spaces, the condition is called pneumothorax. Mechanical injuries or diffuse diseases of the lung that distort lung architecture can lead to pneumothorax. Such diseases include emphysema, asthma, and cystic fibrosis. The most common symptom of pneumothorax is sudden pain on one side of the lung accompanied by shortness of breath.

### **Infections**

Infections are a major cause of respiratory illness. They can be caused by bacteria or viruses and can affect not only the lung but also the nose, sinuses, ears, teeth, and gums. Infections may also complicate other lung diseases.

*Pneumonia*, or inflammation of the lungs, is the most common type of infectious disease of the lung. Infectious pneumonias are usually identified by naming the cause of the infection or the pattern of the infection in the respiratory tract. More than half the cases of pneumonia are caused by the bacterium, *Streptococcal pneumoniae* (*pneumococcus*) and are called pneumococcal pneumonia. *Influenza A* is the cause of a significant number of cases of pneumonia in the elderly during the winter months. Another well known form of pneumonia is *Legionnaires' disease*, which is caused by the organism, *Legionella pneumophila*.

The inflammatory response of the lung in pneumonia varies depending on the type of infection, and might include:

- lobar consolidation: solidification of the lung as air spaces are filled with fluid and cellular material, and
- interstitial inflammation.

Pneumonia is sometimes accompanied by:

- necrosis: tissue changes accompanying cell death,
- cavitation: hollow spaces walled off by scar tissue,
- abscess: pus formation, and
- granuloma formation: production of tumor-like masses of different kinds of cells due to a chronic inflammatory response.

*Tuberculosis* is a granulomatous infectious disease caused by an organism called *Mycobacterium tuberculosis*.

## **Lung Cancer**

Deaths from lung cancer were virtually unknown in the United States until 1900, but have steadily increased since then. Currently, lung cancer is responsible for almost one-third of all cancer deaths in this country. The incidence of lung cancer may have reached its peak in men, but it is continuing to rise in women. More than 90 percent of patients with lung cancer are, or have been, cigarette smokers. Smoking marijuana increases the risk of cancer for cigarette smokers. Quitting cigarette smoking reduces the incidence of lung cancer, but the level of risk reaches that of a nonsmoker only after the person has remained a nonsmoker for 10 to 15 years.

*Types of Lung Cancer:* Cancers of the cells that line the major bronchi or their primary branches are called *squamous cell carcinomas*. This type of cancer metastasizes (spreads) mostly to other sites within the thorax. *Adenocarcinomas* are cancers of the glandular cells that line the respiratory tract. They most often start at the outer edges of the lungs and spread to the brain, the other lung, liver, and bones. *Large cell carcinomas* usually begin in the outermost parts of the lung. By the time they are diagnosed, they are often seen as large, bulky tumors. *Small cell carcinomas*, also called “oat cell” cancers, usually begin in the bronchi. Small cell carcinomas metastasize widely to the mediastinum, liver, bones, bone marrow, central nervous system, and pancreas.

Because respiratory problems are so often caused by environmental exposure to irritants and infectious agents, smoking tobacco, and occupations that involve inhaling dangerous substances, many lung diseases can be prevented by following some simple guidelines:

- Do not smoke tobacco or other products.
- Avoid exposure to dusts and irritants that can harm your lungs.
- Wear proper protective devices if you must work in environments that contain respiratory irritants.

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