16.7: Case Study Bronchitis Conclusion and Chapter Summary

Case Study Conclusion: Cough That Won't Quit

The little child shown in Figure \(\PageIndex{1}\) seems to be enjoying the air coming out of a humidifier. Inhaling the moist air from a humidifier or steamy shower can feel particularly good if you have a respiratory system infection, such as bronchitis. The moist air helps to loosen and thin mucus in the respiratory system, allowing you to breathe easier.

At the beginning of this chapter, you learned about Erica, who developed acute bronchitis after getting a cold. She had a worsening cough, sore throat due to coughing, and chest congestion. She was also coughing up thick mucus.

Acute bronchitis usually occurs after a cold or flu, usually due to the same viruses that cause cold or flu. Because...
Bronchitis is not usually caused by bacteria (although it can be), antibiotics are not an effective treatment in most cases.

Bronchitis affects the bronchial tubes, which, as you have learned, are air passages in the lower respiratory tract. The main bronchi branch off of the trachea and then branch into smaller bronchi and then bronchioles. In bronchitis, the walls of the bronchi become inflamed, which makes them narrower. Also, there is excessive production of mucus in the bronchi, which further narrows the pathway through which air can flow. Figure \( \PageIndex{2} \) shows how bronchitis affects the bronchial tubes.

The function of mucus is to trap pathogens and other potentially dangerous particles that enter the respiratory system from the air. However, when too much mucus is produced in response to an infection (as in the case of bronchitis), it can interfere with normal airflow. The body responds by coughing as it tries to rid itself of the pathogen-laden mucus.

The treatment for most cases of bronchitis involves thinning and loosening the mucus so that it can be effectively coughed out of the airways. This can be done by drinking plenty of fluids, using humidifiers or steam, and in some cases, using over-the-counter medications such as expectorants that are found in some cough medicines. This is why Dr. Johnson recommended some of these treatments to Erica and also warned against using cough suppressants. Cough suppressants work on the nervous system to suppress the cough reflex. When a patient has a “productive” cough—i.e. they are coughing up mucus—doctors generally advise them to not take cough suppressants so that they can cough the mucus out of their bodies.

When Dr. Johnson was examining Erica, she used a pulse oximeter to measure the oxygen level in her blood. Why did she do this? As you have learned, the bronchial tubes branch into bronchioles, which ultimately branch into the alveoli of the lungs. The alveoli are where gas exchange occurs between the air and the blood to take in oxygen and remove carbon dioxide and other wastes. By checking Erica’s blood oxygen level, Dr. Johnson was making sure that her clogged airways were not impacting her level of much-needed oxygen.
Erica has acute bronchitis, but you may recall that chronic bronchitis was discussed earlier in this chapter as a term that describes the symptoms of chronic obstructive pulmonary disease (COPD). COPD is often due to tobacco smoking and causes damage to the walls of the alveoli, whereas acute bronchitis typically occurs after a cold or flu and involves inflammation and mucus build-up in the bronchial tubes. As implied by the difference in their names, chronic bronchitis is an ongoing, long-term condition, while acute bronchitis is likely to resolve relatively quickly with proper rest and treatment.

However, Erica smokes cigarettes, so she is more likely to develop chronic respiratory conditions such as COPD. As you have learned, smoking damages the respiratory system as well as many other systems of the body. Smoking increases the risk of respiratory infections, including bronchitis and flu, due to its damaging effects on the respiratory and immune systems. Dr. Johnson strongly encouraged Erica to quit smoking, not only so that her acute bronchitis resolves, but so that she can avoid future infections and other negative health outcomes associated with smoking, including COPD and lung cancer.

As you have learned in this chapter, the respiratory system is critical to carry out the gas exchange necessary for life’s functions and to protect the body from pathogens and other potentially harmful substances in the air. But this ability to interface with the outside air has a cost. The respiratory system is prone to infections, as well as damage and other negative effects from allergens, mold, air pollution, and cigarette smoke. Although exposure to most of these things cannot be avoided, not smoking is an important step you can take to protect this organ system—as well as many other systems of your body.

Chapter Summary

In this chapter, you learned about the respiratory system. Specifically, you learned that:

• Respiration is the process in which oxygen moves from the outside air into the body and carbon dioxide and other waste gases move from inside the body into the outside air. It involves two subsidiary processes: ventilation and gas exchange.

• The organs of the respiratory system form a continuous system of passages called the respiratory tract. It has two major divisions: the upper respiratory tract and the lower respiratory tract.
  ◦ The upper respiratory tract includes the nasal cavity, pharynx, and larynx. All of these organs are involved in conduction or the movement of air into and out of the body. Incoming air is also cleaned, humidified, and warmed as it passes through the upper respiratory tract. The larynx is also called the voice box because it contains the vocal cords, which are needed to produce vocal sounds.
  ◦ The lower respiratory tract includes the trachea, bronchi and bronchioles, and the lungs. The trachea, bronchi, and bronchioles are involved in conduction. Gas exchange takes place only in the lungs, which are the largest organs of the respiratory tract. Lung tissue consists mainly of tiny air sacs called alveoli, which is where gas exchange takes place between the air in the alveoli and the blood in capillaries surrounding them.

• The respiratory system protects itself from potentially harmful substances in the air by the mucociliary escalator. This includes mucus-producing cells, which trap particles and pathogens in the incoming air. It also includes tiny hair-like cilia that continually move to sweep the mucus and trapped debris away from the lungs and toward the outside of the body.

• The level of carbon dioxide in the blood is monitored by cells in the brain. If the level becomes too high, it triggers a faster rate of breathing, which lowers the level to the normal range. The opposite occurs if the level becomes too low. The respiratory system exchanges gases with the outside air, but it needs the cardiovascular system to carry the gases to and from cells throughout the body.
• Breathing, or ventilation, is the two-step process of drawing air into the lungs (inhaling) and letting the air out of the lungs (exhaling). Inhaling is an active process that results mainly from the contraction of a muscle called the diaphragm. Exhaling is typically a passive process that occurs mainly due to the elasticity of the lungs when the diaphragm relaxes.

  ◦ Breathing is one of the few vital bodily functions that can be controlled consciously as well as unconsciously. Conscious control of breathing is common in many activities, including swimming and singing. However, there are limits on the conscious control of breathing. If you try to hold your breath, for example, you will soon have an irrepressible urge to breathe.
  ◦ Unconscious breathing is controlled by respiratory centers in the medulla and pons of the brainstem. They respond to variations in blood pH by either increasing or decreasing the rate of breathing as needed to return the pH level to the normal range.
  ◦ Nasal breathing is generally considered to be superior to mouth breathing because it does a better job of filtering, warming, and moistening incoming air. It also results in slower emptying of the lungs, which allows more oxygen to be extracted from the air.

• Gas exchange is the biological process through which gases are transferred across cell membranes to either enter or leave the blood. Gas exchange takes place continuously between the blood and cells throughout the body and also between the blood and the air inside the lungs.

  ◦ Gas exchange in the lungs takes place in alveoli. The pulmonary artery carries deoxygenated blood from the heart to the lungs, where it travels through pulmonary capillaries, picking up oxygen, and releasing carbon dioxide. The oxygenated blood then leaves the lungs through pulmonary veins.
  ◦ Gas exchange occurs by diffusion across cell membranes. Gas molecules naturally move down a concentration gradient from an area of higher concentration to an area of lower concentration. This is a passive process that requires no energy.
  ◦ Gas exchange by diffusion depends on the large surface area provided by the hundreds of millions of alveoli in the lungs. It also depends on a steep concentration gradient for oxygen and carbon dioxide. This gradient is maintained by continuous blood flow and constant breathing.

• Asthma is a chronic inflammatory disease of the airways in the lungs, in which the airways periodically become inflamed. This causes swelling and narrowing of the airways, often with excessive mucus production, leading to difficulty breathing and other symptoms. Asthma is thought to be caused by a combination of genetic and environmental factors. Asthma attacks are triggered by allergens, air pollution, or other factors.

• Pneumonia is a common inflammatory disease of the respiratory tract in which inflammation affects primarily the alveoli, which become filled with fluid that inhibits gas exchange. Most cases of pneumonia are caused by viral or bacterial infections. Vaccines are available to prevent pneumonia; treatment often includes prescription antibiotics.

• Chronic obstructive pulmonary disease (COPD) is a lung disease characterized by chronic poor airflow, which causes shortness of breath and a productive cough. It is caused most often by tobacco smoking, which leads to the breakdown of connective tissues in the lungs. Alveoli are reduced in number and elasticity, making it impossible to fully exhale air from the lungs. There is no cure for COPD, but stopping smoking may reduce the rate at which COPD worsens.

• Lung cancer is a malignant tumor characterized by uncontrolled cell growth in tissues of the lung. It results from accumulated DNA damage, most often caused by tobacco smoking. Lung cancer is typically diagnosed late, so most cases cannot be cured. It may be treated with surgery, chemotherapy, and/or radiation therapy.

• Smoking is the single greatest cause of preventable death worldwide. It has adverse effects on just about every body system and organ. Tobacco smoke affects not only smokers but also non-smokers who are exposed to secondhand smoke. The nicotine in tobacco is highly addictive, making it very difficult to quit smoking.

  ◦ The major health risk of smoking is cancer of the lungs. Smoking also increases the risk of many other types of cancer. Tobacco smoke contains dozens of chemicals that are known carcinogens.
  ◦ Smoking is the primary cause of COPD. Chemicals such as carbon monoxide and cyanide in tobacco smoke reduce the elasticity of alveoli so the lungs can no longer fully exhale air.
Smoking damages the cardiovascular system and increases the risk of high blood pressure, blood clots, heart attack, and stroke. Smoking also has a negative impact on levels of blood lipids.

A wide diversity of additional adverse health effects are attributable to smoking, such as erectile dysfunction, female infertility, and slow wound healing.

Chapter Summary Review

1. Describe the relationship between the bronchi, secondary bronchi, tertiary bronchi, and bronchioles.
2. What is the uppermost structure in the lower respiratory tract?
   A. Bronchus
   B. Lung
   C. Alveolus
   D. Trachea
3. Deoxygenated and oxygenated blood both travel to the lungs. Describe what happens to each there.
4. True or False. There are radioactive isotopes in cigarette smoke.
5. True or False. The right and left lungs are identical in structure.
6. Explain the difference between ventilation and gas exchange.
7. Which way do oxygen and carbon dioxide flow during a gas exchange in the lungs? Why does this happen? Which way do oxygen and carbon dioxide flow during the gas exchange between the blood and the body’s cells? Why does this happen?
8. Why does the body require oxygen and give off carbon dioxide as a waste product?
10. True or False. Gas exchange does not require energy.
11. What do coughing and sneezing have in common?
12. The ___________ escalator protects the respiratory system.
   A. phlegmociliary
   B. mucociliary
   C. mucoflagellar
   D. surfactociliary
13. COPD can lead to too much carbon dioxide in the blood. Answer the following questions about this.
   A. Why can COPD cause there to be too much carbon dioxide in the blood?
   B. What does this do to the blood pH?
   C. How does the body respond to this change in blood pH?
14. From the following list of diseases, choose which one best fits each description. Each disease is used only once. Diseases: asthma, pneumonia, COPD, lung cancer
   A. Alveoli become inflamed and fill with fluid
   B. Can be caused by exposure to inhaled carcinogens
   C. There is a reduction in the number of alveoli
   D. Airways periodically narrow and fill with mucus
15. True or False. Pneumonia can be caused by fungi.
16. True or False. The diaphragm contracts during exhalation.
17. What are three different types of things that can enter the respiratory system and cause illness or injury? Describe the negative health effects of each in your answer.
18. Where are the respiratory centers of the brain located? What is the main function of the respiratory centers of the
19. Smoking increases the risk of getting influenza, commonly known as the flu. Explain why this could lead to a greater risk of getting pneumonia.

20. If people had a gene that caused them to get asthma, could changes to their environment (such as more frequent cleaning) help their asthma? Why or why not?

21. What does the term bronchodilator refer to?
   A. The largest bronchial tube
   B. An area of the brain that increases breathing rate
   C. A medication that opens constricted airways
   D. A medication that clears the nasal cavity

22. Explain why nasal breathing generally stops particles from entering the body at an earlier stage than mouth breathing.