Coronary Artery Disease

11.5

Many diseases and disorders can affect the functioning of the circulatory system. Whatever the nature of the disorder, the fundamental problem is that it interferes with the delivery of oxygen and other substances around the body. The most common circulatory system disorders are those that affect the heart directly, and the most common form of heart disease involves problems with the coronary arteries.

Arteriosclerosis

As you learned in Section 11.3, the elasticity in healthy arteries helps them to effectively circulate blood through the body. Over time, too much pressure in the arteries can result in the hardening and loss of elasticity of the arterial walls. This process is called **arteriosclerosis**, or hardening of the arteries.

One way in which arteries harden involves fatty deposits, called **plaque**, building up on or just underneath the inside walls of arteries. Fat, cholesterol, calcium, and other materials that are normally present in the blood can accumulate inside the arteries to form plaque (**Figure 1**). This hardening of the arteries due to plaque buildup creates a condition known as **atherosclerosis**. Atherosclerosis can occur in any artery of the body. When it occurs in the coronary arteries, it is referred to as **coronary artery disease (CAD)** or coronary heart disease. Next to cancer, CAD is the leading cause of death in Canada.

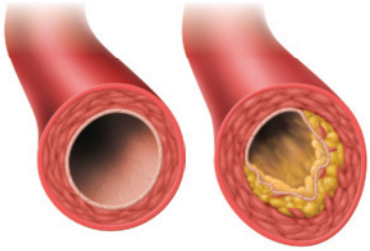

Figure 1 Plaque buildup on and underneath the artery wall. This reduces or blocks the flow of blood.

arteriosclerosis the loss of elasticity and hardening of the arteries that may be caused by a number of factors including hypertension, age, and plaque buildup

plaque deposits of fat, cholesterol, calcium, and other materials on and in the walls of arteries

atherosclerosis the hardening of the arteries due to the buildup of plaque on or inside the walls of the arteries; atherosclerosis is the most common form of arteriosclerosis

coronary artery disease (CAD) the buildup of plaque on or inside the walls of the coronary arteries

Risk Factors for Coronary Artery Disease

The major risk factors that contribute to CAD are high blood pressure, high cholesterol, diabetes, being overweight or obese, smoking, physical inactivity, gender, genetics, and age. Any one of these factors may not be critical in itself, but a combination of factors significantly increases the risk of heart disease. These factors are also interrelated. For example, obesity can increase the chances of developing other risk factors, such as high blood pressure, high blood cholesterol, or diabetes.

One of the major risk factors is high cholesterol. Cholesterol is a fatty substance produced in the liver and carried in the blood to all cells. Cholesterol is an important substance because it is used in building cell membranes and hormones. About 70 % of the cholesterol in the body is produced in the liver; the remaining 30 % comes from foods such as meat, eggs, and dairy products, which contain cholesterol. Cholesterol and other fats do not dissolve in the blood, so they cannot move throughout the body by themselves. Instead, they are transported in the blood by special carriers called lipoproteins. There are two types of lipoprotein—high-density lipoprotein (HDL), commonly referred to as "good cholesterol," and low-density lipoprotein (LDL), commonly referred to as "bad cholesterol." A high level of LDL in the blood contributes to the buildup of plaque on the walls of arteries. HDL seems to have the opposite effect, by carrying cholesterol back to the liver where it is removed from the body.

Symptoms of Coronary Artery Disease

Without diagnostic testing, individuals may not be aware that they have CAD. However, a common symptom is angina. **Angina** is pain most often in the chest area but also in the left shoulder, arm, or neck. Angina may range from a low-level discomfort or tightness to more severe aching or pressure. It is often mistaken for indigestion or heartburn. Angina is caused by reduced blood supply to the cardiac muscles and is often triggered by physical activity that increases the demand for oxygen. Angina is most commonly treated with a drug called nitroglycerin. Nitroglycerin is a vasodilator; it dilates or increases the diameter of the coronary arteries to increase the blood flow to the heart muscles.

angina pain in the chest, left shoulder, arm, or neck caused by insufficient blood supply to the cardiac muscles

Heart Attack: A Consequence of Coronary Artery Disease

myocardial infarction the death of cardiac muscle tissue due to oxygen deprivation; also known as a heart attack

One of the frequent consequences of CAD is a heart attack or myocardial infarction. A **myocardial infarction** is the death of an area of heart muscle tissue due to oxygen deprivation. If the surface of one of the plaques in a coronary artery ruptures, a blood clot will form at the site of the rupture. This blood clot blocks the flow of blood to some of the heart muscle cells. If blood flow is not restored within 20 min to 40 min, those muscle cells begin to die. Cells will continue to die for six to eight hours, so it is extremely important to receive treatment as early as possible. A heart attack may be fatal if a large area of cardiac muscle is affected. A heart attack may also lead to death if the attack interferes with the heart rhythm and the heart stops beating. When this happens, it is referred to as cardiac arrest.

LEARNING **TIP**

Word Origins
Myo means "muscle," *cardial* means "of the heart," and *infarct* means "plug up or block." Together, "myocardial infarction" means that the supply of blood to the heart muscle is blocked.

Although a heart attack usually occurs suddenly, warning symptoms often occur hours, days, or even weeks before an attack. The most common symptoms are chest pain or pressure and difficulty breathing. Other common symptoms include pain in the arm, back, or jaw; nausea; vomiting; and sweating. There are challenges in predicting a heart attack, and the symptoms are not always the same for everyone. In approximately one quarter of all instances there are no symptoms. Furthermore, some of the common symptoms, such as nausea, heartburn, or stomach cramps, are attributed to indigestion or other digestive system problems rather than circulatory system problems.

Treatment for Coronary Artery Disease

Several options are available to treat heart attacks, depending on the extent and severity of the blocked arteries. These options include lifestyle changes, angioplasty, and bypass surgery.

angioplasty a medical procedure that opens up a blocked artery; it is often used to enlarge narrowed openings in coronary arteries

Three major lifestyle changes are often recommended to prevent or alleviate heart attacks and CAD in general: regular exercise, a healthier diet, and quitting smoking. Regular exercise increases HDL (good cholesterol) in some people, and it helps control other risk factors such as high blood pressure, diabetes, and obesity. Medications may also be used in combination with these lifestyle changes to reduce the buildup of plaque in the arteries.

WEB **LINK**

To learn more about the causes, symptoms, and treatments of heart attacks,

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Angioplasty involves opening up a blocked artery by inflating a small balloon at the point of the blockage. The balloon presses the buildup of plaque against the wall of the artery and widens the opening (**Figure 2(a)**). An expandable mesh tube, called a stent, may be placed at the site of the blockage to ensure that the artery remains open (**Figure 2(b)**). A laser could also be used to vaporize the plaque and open up the artery.

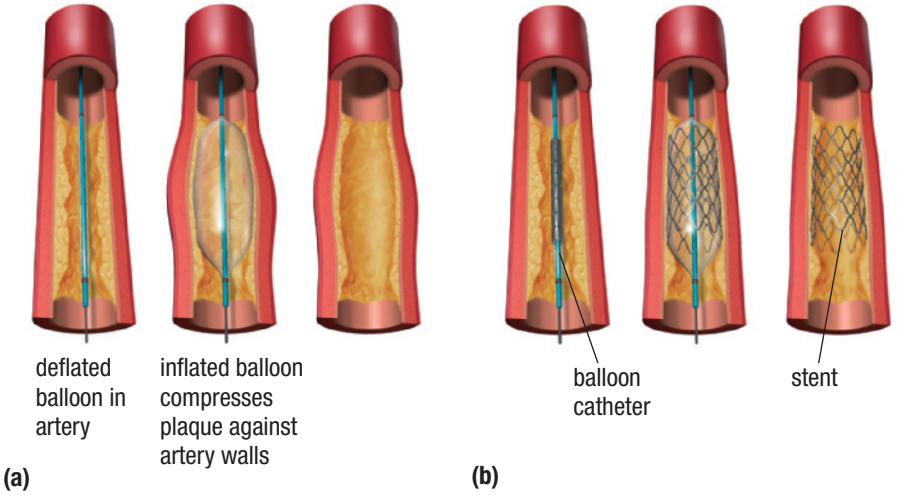

Figure 2 (a) A blocked artery can be opened up using balloon angioplasty. (b) A stent is sometimes used in angioplasty to ensure that the blocked artery remains open at the site of the plaque buildup.

Coronary artery bypass grafting, commonly called **bypass surgery**, is a type of surgery that reroutes, or "bypasses," blood around clogged coronary arteries to improve blood flow and oxygen to the heart muscles. In this procedure, arteries or veins from another part of the body, most commonly a vein from the leg, are grafted to the coronary arteries to bypass a blocked artery (**Figure 3**). This creates an alternate passage for blood to flow around the blockage.

Bypass surgery is usually performed with the heart stopped and is undertaken only in severe cases if other, less invasive treatments, such as angioplasty, are not appropriate. The graft artery can also become blocked if the patient does not take prescribed medications and make appropriate lifestyle changes.

Although bypass surgery is a life-saving procedure, it is not without risks. It involves cutting open the thoracic cavity by cutting through the sternum (breastbone). This is a major surgery and, as with any surgery, there are risks such as bleeding, infections, poor healing, and other complications.

bypass surgery a surgical procedure in which arteries are grafted to blocked (or narrowed) coronary arteries in order to reroute blood flow and oxygen to the heart

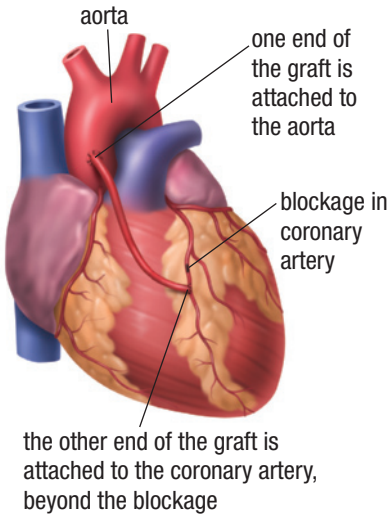

Figure 3 A coronary bypass redirects blood around the blockage in the coronary artery so that the heart muscles receive an adequate blood supply.

11.5 Summary

- Atherosclerosis is the condition that results from the buildup of plaque in the arteries. The buildup of plaque reduces blood flow, and a rupture of the plaque can create a clot that completely blocks the flow of blood.
- Atherosclerosis in the coronary arteries is referred to as CAD.
- A common symptom of CAD is angina, or pain in the chest area, caused by insufficient blood supply to the heart muscles.
- A myocardial infarction, or heart attack, can occur when the blood supply to the heart muscles is blocked. A heart attack results in the death of cardiac muscle tissue due to oxygen deprivation.
- When blockages occur in the coronary arteries, procedures such as angioplasty and bypass surgery can restore blood flow to muscles of the heart.
- Lifestyle changes such as appropriate diet, increased physical activity, and stopping smoking can reduce the risk of or alleviate heart disease.

11.5 Questions

1. Describe the condition known as atherosclerosis. What factors contribute to the development of this condition? K/U A
2. (a) Explain how cholesterol is an important factor in coronary artery disease (CAD).
   (b) Why is LDL cholesterol referred to as "bad cholesterol" and HDL cholesterol as "good cholesterol"? K/U A
3. Use the Internet and other sources to find out how smoking, blood pressure, diabetes, and genetics all contribute to CAD. Write a brief summary of your findings. T/I A C
4. A 50-year-old male who is not overweight and has normal blood cholesterol levels suffers a heart attack. Propose a possible explanation. K/U T/I A
5. Explain how CAD can lead to a heart attack. K/U A
6. Use the Internet and other sources to find out the symptoms of a heart attack and the recommended actions that should be taken. Prepare a brochure with essential information to distribute to family and friends. T/I C A
7. Suppose a friend is overweight and inactive, and a recent blood test revealed high levels of LDL cholesterol. Being sensitive to your friend's feelings, write a letter discussing the risks associated with these factors and recommend lifestyle changes that might reduce the risks. K/U C A

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