2. Investigate the function of at least five common medications used to treat the integumentary system.
3. List at least five occupations involved in the health care of integumentary system disorders.
4. Describe three commercials that are used to sell skin and hair products. Identify the technique or claim in each that is used to sell the product.
5. Write an essay about pressure sores. Research and report the incidence of pressure sores (decubitus ulcers) in long-term care facilities. Describe the daily care of an immobilized patient that would reduce the risk for development of a pressure sore. Research and report the treatment methods used for pressure sores.
6. Investigate the incidence of tattooing and state regulations or guidelines. Compare the positive and negative aspects of tattoos.
7. Use the Internet to investigate and prepare a pamphlet that tells readers about good skin care.
8. Use the Internet to investigate and prepare a report on a skin disorder. Include the incidence, cause, signs, symptoms, treatment, and method of prevention if any is known.

Skin Care
Kid's Health
http://kidshealth.org/kid/stay_healthy/body/skin_care.html

Mayo Clinic
http://www.mayoclinic.com/health/skin-care/5120003

Skin Disorders
Merck
http://www.merck.com/mmhe/sec18.html

Web MD
http://www.webmd.com/skin-problems-and-treatments/default.htm

Skin Cancer
Skin Care Physicians
http://www.skincarephysicians.com/skincancernet/whatis.html

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Cardiovascular System

LEARNING OBJECTIVES
- Define at least 10 terms relating to the cardiovascular system.
- Describe the function of the cardiovascular system.
- Identify at least 10 cardiovascular system structures and the function of each.
- Identify at least three methods of assessment used to evaluate the cardiovascular system.
- Describe at least five disorders of the cardiovascular system.

KEY TERMS
- Cardioversion (kar-dee-oh-VER-zhun) Restoration of normal heart rhythm by electrical shock
- Contract (kon-TRAKT) Shorten, reduce in size
- Coronary (kor uh-nay ree) Pertaining to the heart; coronary arteries supply blood to the heart muscle
- Diastole (di AS to lee) Dilation of the heart; resting phase or filling of the ventricles, alternating with systole
- Infarction (in FAR kshun) An area of tissue death (necrosis) caused by loss of oxygen (ischemia) as a result of obstruction of circulation to the area
- Pulmonary circulation (pul muh nay ee ser kyuh LAY zhun) Carrying venous blood from the right ventricle to the lungs and returning oxygenated blood to the left atrium of the heart
- Rate (rayt) Expression of speed or frequency of an event in relation to a specified amount of time; number of contractions of the heart per minute
- Rhythm (RI th um) Measured movement; recurrence of an action or function at regular intervals; interval of heart contractions
- Stenosis (ste NO sis) Narrowing or stricture of a duct or canal
- Stethoscope (STETH o skohp) Instrument used to listen to body sounds (auscultation), such as the heartbeat
KEY TERMS cont'd

Systemic circulation (sis-TEM-ik ser-kyuh-LAY-shun) General circulation; carrying oxygenated blood from the left ventricle to tissues of the body and returning the venous blood to the right atrium of the heart

Systole (sis-toe-le) Filling of the atria and contraction of the ventricles of the heart, alternating with diastole

Vessel (VES-el) Any one of many tubules in the body that carry fluid

Cardiovascular System Terminology

Hypertrophic cardiomyopathy is a congenital or genetic condition that may cause heart failure without symptoms. (From Patton KT, Thibodeau GA: Anatomy & physiology, ed 7, St. Louis, 2010, Mosby.)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Prefix</th>
<th>Root</th>
<th>Suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atherosclerosis</td>
<td>Condition of hardening of the arteries</td>
<td>ather/o</td>
<td>scler/o</td>
<td>sis</td>
</tr>
<tr>
<td>Cardiology</td>
<td>Study of the heart</td>
<td>card/o</td>
<td>ology</td>
<td></td>
</tr>
<tr>
<td>Congenital</td>
<td>Born with</td>
<td>con</td>
<td>gen</td>
<td>ital</td>
</tr>
<tr>
<td>Electrocardiography</td>
<td>Recording of the electrical activity of the heart</td>
<td>electro</td>
<td>card/o</td>
<td>graphy</td>
</tr>
<tr>
<td>Hypertension</td>
<td>High blood pressure</td>
<td>hyper</td>
<td>tension</td>
<td></td>
</tr>
<tr>
<td>Myocardial</td>
<td>Pertaining to the muscle of the heart</td>
<td>myo</td>
<td>card</td>
<td>ial</td>
</tr>
<tr>
<td>Pericardial</td>
<td>Around the heart</td>
<td>peri</td>
<td>card</td>
<td>ial</td>
</tr>
<tr>
<td>Phlebitis</td>
<td>Inflammation of the veins</td>
<td>phleb</td>
<td>itis</td>
<td></td>
</tr>
<tr>
<td>Subclavicular</td>
<td>Below the clavicle</td>
<td>sub</td>
<td>clav</td>
<td>ian</td>
</tr>
<tr>
<td>Thrombosis</td>
<td>Inflammation of a clot</td>
<td>thromb</td>
<td>itis</td>
<td></td>
</tr>
</tbody>
</table>

* A transition syllable or vowel may be added to or deleted from the word parts to make the combining form.

Abbreviations of the Cardiovascular System

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>Apical</td>
</tr>
<tr>
<td>BP</td>
<td>Blood pressure</td>
</tr>
<tr>
<td>CHF</td>
<td>Congestive heart failure</td>
</tr>
<tr>
<td>chol</td>
<td>Cholesterol</td>
</tr>
<tr>
<td>ECG</td>
<td>Electrocardiogram</td>
</tr>
<tr>
<td>HB</td>
<td>Heartbeat</td>
</tr>
<tr>
<td>HDL</td>
<td>High-density lipoprotein</td>
</tr>
<tr>
<td>LDL</td>
<td>Low-density lipoprotein</td>
</tr>
<tr>
<td>MI</td>
<td>Myocardial infarction</td>
</tr>
<tr>
<td>PVC</td>
<td>Premature ventricular contraction</td>
</tr>
</tbody>
</table>

Structure and Function of the Cardiovascular System

The structures of the cardiovascular system are the heart and blood vessels. The heart beats more than 100,000 times a day, circulating about 5 L of blood. The functions of the cardiovascular system are the following:

- Distribute hormones and antibodies throughout the body
- Help control body temperature and maintain electrolyte balance (homeostasis)

Heart

The heart is a two-sided, double pump. It weighs less than a pound and is slightly larger than a fist. The heart is located between the lungs in the thoracic cavity, positioned partially to the left of the sternum. The base or topmost (superior) part of the heart has a flatter shape than the tapered apex or lower (inferior) portion.

The right side of the heart pumps oxygen-poor (deoxygenated) blood to the lungs, where carbon dioxide is exchanged for oxygen. This is referred to as pulmonary circulation. The left side pumps the oxygen-rich (oxygenated) blood to the rest of the body. This is referred to as systemic circulation. The blood returns to the right side of the heart from the body to complete the cycle (Fig. 11-1).

Hepatic circulation refers to the path of the blood from the intestines, gallbladder, pancreas, stomach, and spleen through the liver. The liver stores and modifies nutrients in the blood for use by the body. It also removes or alters toxic substances so that they can be eliminated by the urinary system. The nutrient-rich blood, which has been filtered by the liver, is returned to the heart through the inferior vena cava for use throughout the body.

The heart has four chambers (Fig. 11-2). The top chambers are called atria. The lower chambers are called ventricles. The blood enters the heart through the atria and leaves the heart from the ventricles. The septum divides the right and left sides of the heart. Four valves prevent the blood from flowing backward through the system. Two of these valves are called atrioventricular (AV) valves. They separate the atria and ventricles on each side of the heart. The semilunar

BRAIN BYTE

The heart pumps 5 quarts of blood a minute or about 2000 quarts each day.

Figure 11-1 Blood flow through the cardiovascular system. (From Patton KT, Thibodeau GA: Anatomy & physiology, ed 7, St. Louis, 2010, Mosby.)

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Valves separate the ventricles from the outgoing vessels (pulmonary artery and aorta). The valves are named according to their structure (semilunar) and location (pulmonary or aortic).

The heart has three layers of tissue. The endocardium is a smooth layer of cells lining the inside of the heart and forming the valves. The smoothness of the endocardial tissue helps prevent damage to blood cells circulating through the system. The myocardium is the thickest layer, consisting of muscle tissue. This part of the heart pumps blood through the system. The pericardium is a double membrane that covers the outside of the heart, providing lubrication between the heart and surrounding structures to prevent tissue damage. The pericardial sac is made up of the inner serous (water) and outer fibrous layers.

The activity of the heart muscle is controlled largely by the nervous system but is affected also by the action of hormones and other mechanisms such as fluid balance. Additionally, the heart contains the only muscle tissue that can stimulate its own contractions. Specialized sinoatrial (SA) cells in the right atrium (SA node) act as a pacemaker to start a heart contraction (Fig. 11-3). The change in the electrical potential of these cells stimulates another group of cells, called the atrioventricular node (AV node), to send the impulse into the lower portions of the heart. The impulse of the AV node stimulates specialized bundles of muscle called the AV bundle or bundle of His. These fibers then stimulate the Purkinje fibers, which surround the lower portions of the ventricles. The Purkinje fibers cause the ventricles to contract. Another unique property of the heart is the ability to adjust the strength of the contractions on the basis of the amount of blood in its chambers. Without the influence of the nervous system and other controls, the heart would contract only 40 times each minute instead of the normal 60 to 90 times. The adult heart beats 10,000 times a day.

**Blood Vessels**

The body has three main types of blood vessels (Fig. 11-4):

- Arteries carry blood away from the heart.
- Veins carry blood back to the heart.
- Capillaries are microscopic vessels that carry blood between the arterial and venous vessels.

Blood is pumped from the heart to the body by the largest artery in the body, the aorta. Fig. 11-5 shows the principal arteries of the body. The aorta branches into other arteries, which in turn branch into smaller vessels called arterioles. The blood moves from arterioles to microscopic capillaries. Gases, nutrients, and wastes are exchanged through the thin walls of the capillaries. The blood, which has now given up its oxygen, flows from the capillaries into tiny veins called venules. Venules branch together to form larger veins (Fig. 11-5). The blood is returned to the heart in the body's largest veins, the superior vena cava and inferior vena cava. With the exception of the pulmonary artery, blood in the arteries is oxygenated. Except for the pulmonary vein, blood in veins is deoxygenated.

Arteries have a muscular layer of tissue that helps pump blood out to the body. Veins have a much thinner muscular layer. Gravity and the movement of
the muscles surrounding the veins help deliver blood back to the heart. Veins also have valves that prevent blood from flowing back, away from the heart, once it has moved forward.

Path of the Blood Through the Heart

Tracing the path of a blood cell through the heart is one way to learn the heart’s structures and understand its functions (Table 11-1). Although the heart is considered a two-sided pump to differentiate the systemic and pulmonary circulation, the two atria contract at the same time, then the ventricles contract. Deoxygenated blood enters the right atrium of the heart from the body through the inferior and superior vena cavae. Additionally, blood from the heart muscle itself returns through a structure called the coronary sinus. The blood then passes through the tricuspid valve into the right ventricle. This valve closes as the pulmonary valve opens, allowing the passage of blood from the right ventricle to the pulmonary arteries. The pulmonary valve closes as the blood enters the lungs for the diffusion of oxygen and carbon dioxide. The oxygenated blood then travels through the pulmonary veins to the left atrium. From the left atrium the blood travels through the bicuspid or mitral valve to the left ventricle. The mitral valve closes as the blood leaves the left ventricle through the aortic valve. The blood then travels through the aorta to the rest of the body. As the ascending aorta leaves the heart, it branches in three directions to supply blood to the head and upper limbs. Two coronary arteries, which supply blood to the heart, branch off of the ascending aorta. The descending portion of the aorta supplies blood to the abdominal area and lower extremities. Deoxygenated blood is returned to the heart through the inferior and superior vena cavae from the body to complete the path.

Assessment Techniques

Health care workers assess the activity of the heart as an indicator of overall body condition. Methods to assess the heart’s condition include the following:

- Measuring pulse and blood pressure
- Listening to heart sounds
- Determining cardiac output
- Measuring muscle activity with electrocardiography
- Inserting a cardiac catheter
- Using echocardiography
- Radionuclide imaging

Pulse

With each heartbeat, blood surges against the walls of arteries. That surge, called a pulse, can be felt and counted in arteries close to the skin. The pulse can be counted in eight body locations (Fig. 11-6). The most commonly used site is the radial artery of the wrist. The large carotid artery in the throat is used in emergency situations. The brachial artery is used to measure the blood pressure. Other locations include the temporal, femoral, popliteal, posterior tibial, and pedal arteries. The normal pulse range for adults is 60 to 90 beats per minute, depending on the person’s age, weight, fitness level, and emotional state. A pulse rate outside the normal range may indicate a disorder.

**TABLE 11-1**

<table>
<thead>
<tr>
<th>Structure</th>
<th>Oxygen Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>Exchange of carbon dioxide and oxygen</td>
</tr>
<tr>
<td>Superior and inferior vena cavae</td>
<td>Deoxygenated</td>
</tr>
<tr>
<td>Right atrium</td>
<td>Deoxygenated</td>
</tr>
<tr>
<td>Tricuspid valve</td>
<td>Deoxygenated</td>
</tr>
<tr>
<td>Right ventricle</td>
<td>Deoxygenated</td>
</tr>
<tr>
<td>Pulmonary valve</td>
<td>Deoxygenated</td>
</tr>
<tr>
<td>Pulmonary artery</td>
<td>Deoxygenated</td>
</tr>
<tr>
<td>Lungs</td>
<td>Exchange of carbon dioxide and oxygen</td>
</tr>
<tr>
<td>Pulmonary vein</td>
<td>Oxygenated</td>
</tr>
<tr>
<td>Left atrium</td>
<td>Oxygenated</td>
</tr>
<tr>
<td>Mitral valve</td>
<td>Oxygenated</td>
</tr>
<tr>
<td>Left ventricle</td>
<td>Oxygenated</td>
</tr>
<tr>
<td>Aortic valve</td>
<td>Oxygenated</td>
</tr>
<tr>
<td>Aorta</td>
<td>Oxygenated</td>
</tr>
<tr>
<td>Body</td>
<td>Exchange of carbon dioxide and oxygen</td>
</tr>
</tbody>
</table>

Blood Pressure

Blood pressure is the force of the blood against the walls of the arteries. The systolic blood pressure, or systole, occurs when the ventricles of the heart contract, pumping blood through the arteries. The diastolic pressure, or diastole, occurs when the ventricles relax. Normal blood pressure is written as 120/80 (systolic/diastolic). However, blood pressure varies greatly among people. A healthy systolic pressure is usually less than 120. The diastolic pressure should be less than 90. A blood pressure outside this range may indicate a disorder such as hypertension or renal failure.

Heart Sounds

The "lub-dup" sound of the heart can be heard with a stethoscope. This characteristic sound results from the opening and closing of the valves in the heart as the blood is pumped from the atria to the ventricles and then to the lungs and then throughout the body. Abnormal or extra sounds are called murmurs. Murmurs are classified by the timing, intensity, location, pitch, and quality of the sound. Some heart murmurs are benign (causing no ill effect), but other murmurs indicate a disorder. A vibration caused by an abnormal flow of blood can sometimes be felt by touching over an artery and is called a "thrill."

Cardiac Output

The heart regulates the rate at which the blood circulates to the tissues. This measurement is called the heart rate. The stroke volume is the amount of blood contained in the ventricles. This blood is pumped into the arteries with each heartbeat. The volume of blood that is pumped from the heart by each contraction, multiplied by the heart rate, is called cardiac output:

\[
\text{Stroke volume (mL/beat)} \times \text{Heart rate (beats/min)} = \text{Cardiac output (mL/min)}
\]

For example, the cardiac output of an individual with a heart rate of 70 beats/min and a stroke volume of 70 mL/beat is 4.9 L. The normal cardiac output ranges from 4 to 8 L of blood per minute. The cardiac output affects the blood pressure. An abnormally high or low cardiac output may indicate a disorder of the cardiovascular system.

**CASE STUDY 11-2** Your patient is monitoring his pulse rate because he worries about high blood pressure. You notice that he is counting his pulse for 6 seconds and multiplying by 10. What should you do?

**Answers to Case Studies are available on the Evolve website:** http://evolve.elsevier.com/Gerardin

Electrocardiography

The pattern of electrical activity in heart contractions can be measured graphically using an electrocardiogram (Fig. 11-7). Electrodes attached to different sites
on the body measure electrical changes occurring during heart contractions. Each section of the electrocardiogram pattern indicates a specific part of the heart's electrical activity (Fig. 11-8). Normal and abnormal heart activities have characteristic wave patterns (Fig. 11-9).

Some heart problems appear only during strenuous or specific activities. These can be diagnosed by using stress testing with electrocardiography or by wearing a portable electrocardiograph to compare heart activity with a log of activities during a specified time period.

**Cardiac Catheterization**

Cardiac catheterization is a procedure in which a tube is inserted through a blood vessel into the heart. A dye is then released through the catheter and traced by using radiography. This procedure is called **coronary angiography**. Cardiac catheterization is used to measure the pressure in the chambers of the heart, take blood samples, and view obstructions in the vessels. Ultrasound transducers also have been inserted into the tip of catheter to allow viewing of an image of the inside of the arteries.

**Echocardiography**

Echocardiography is a procedure using ultrasonic waves that show the structures and motion of the heart. This procedure sends high-pitched sounds, which cannot be heard by the human ear, into the body. A special instrument called a **transducer** plots the echoes of these sounds to produce a graphic picture of the heart and valves. Echocardiography is used to detect conditions such as mitral valve defects and atrial tumors. If the image is unclear, a transesophageal echocardiogram may be used. After the back of the throat is numbed, a scope with an ultrasonic device is lowered into the esophagus to complete the echocardiogram.

**Radionuclide Imaging**

Radionuclide imaging, also called **radionuclide scanning**, uses a gamma camera to create an image after injection of a radioactive material such as thallium-201. Single-photon emission CT takes a series of pictures around that chest that are used to generate a three-dimensional computerized image. Myocardial perfusion produces images after the heart muscle absorbs radionuclides. Radiolabeled markers that group in areas of damaged heart tissue are shown in infarct avid imaging.

**FIGURE 11-7** Electrical activity of the heart is measured with electrocardiography. (From Aebi R S.J: Paramedic practice today, St. Louis, 2010, Mosby.)

**FIGURE 11-8** A normal electrocardiogram pattern with descriptions. (From Grauer K: A practical guide to ECG interpretation, ed 2, St. Louis, 1998, Mosby.)

**DISORDERS OF THE Cardiovascular System**

An aneurysm (AN-yoo-rizm) is an area of a blood vessel that bulges because of a weakness in the wall. Most aneurysms occur in the aorta, but they can occur in other vessels. The condition can be congenital and may cause no symptoms, but if an aneurysm ruptures, the person may have a life-threatening drop in blood pressure because blood is released into the body cavities. An aneurysm may be diagnosed if it displaces other body structures. Abnormal blood flow caused by an aneurysm sometimes can be heard with a stethoscope over the area. The sound of this abnormal blood flow is called a bruit. Aneurysms often can be corrected surgically by replacing the weak section of vessel.

Atherosclerosis (ath-er-os-kle-RO-sis) is a narrowing of blood vessels caused by deposits of fatty material containing calcium and cholesterol. This condition is sometimes called “hardening of the arteries” because the vessels lose their elasticity. When this narrowing occurs, the tissue that is deprived of blood will die. The exact cause of atherosclerosis is not known, but poor diet and lack of exercise increase the risk of developing it. Atherosclerosis can occur in any area of the body, but often it is found in the coronary arteries of the heart or in the arteries of the brain. Tissue death in the brain caused by atherosclerosis is called a stroke. Blockage of the blood vessels of the heart results in a heart attack (see following section on myocardial infarction). A person with atherosclerosis may experience chest pain, shortness of breath, fainting, and other indications of insufficient blood supply. Controlling risk factors, such as diet and exercise, may be used to treat atherosclerosis. Surgical removal of fatty deposits is possible in some vessels. Other treatments include drug therapy and surgery to lessen symptoms of the condition.

**Cardiac arrhythmia** (uh-RI-thuh-mee-uh) is a disturbance of the heart’s rhythm caused by a defect in the heart’s pacemaker cells or by damage to heart tissue. The rhythm may be too fast, too slow, or irregular. The person with cardiac arrhythmia may experience dizziness, changes in heart rate, and poor blood circulation. Treatment, if necessary, may include insertion of an artificial pacemaker or implanted cardioverter-defibrillator, the procedure of coronary artery bypass graft (CABG), or medication.

**Coronary artery disease** is a general term for the combined effects of arteriosclerosis, atherosclerosis, and several related conditions, which are collectively called coronary artery disease (CAD). It is responsible for more than 40% of all deaths in the United States and is three times more common than cancer. CAD might appear as a heart attack, peripheral artery disease, angina, or stroke. According to the CDC, heart attack is the leading cause of death of both men and women in the United States. Stroke is the third leading cause. Health care for cardiovascular disease is directed toward prevention, including a healthy diet, exercise, and avoidance of tobacco products. Treatments for CAD may include medication and are numerous (Table 11-2).

**Endoscopic transcatheter sympathetic denervation Angiogenesis**

**Congenital (kon-JEN-i-tal) heart disease** is a group of disorders that affect about one in eight newborns each year in the United States. Although the exact causes of many abnormalities in fetal heart development are not known, genetic or chromosomal and maternal infections such as rubella during pregnancy may be causes. Use of some medication, alcohol, or drug abuse during pregnancy may also result in congenital diseases. Common defects include narrowing, or stenosis, of vessels to the heart and atrial or ventricular septal defects. Coarctation (co-ark-TAY-shun) of the aorta and patent ductus arteriosus (PA-ten DUK-tus ar-tee-O-sus), a condition in which the opening between the pulmonary artery and aorta does not close at birth, may also occur. Individuals with a heart defect often experience shortness of breath and heart block dysfunction of the skin, called cyanosis (si-AN-oh-SIS). This is caused by inadequate perfusion of oxygen to the tissues. Some mild heart defects may not need any treatment or can be treated with medication. Heart defects often can be corrected surgically.

**Congenital (kon-JES-tiv) heart failure** (CHF), usually caused by disease in another body system, is the inability of the heart to pump blood adequately to meet the body’s needs. CHF may occur suddenly or develop over time. It leads to inadequate respiratory and kidney function. The person with CHF usually experiences shortness of breath, rapid heartbeat called tachycardia (tak-ee-KAR-dee-uh), and fluid retention. Treatment includes medication to lessen the symptoms and lifestyle changes to reduce risk factors.

**Hypertension** (hy-per-TEN-shun), also called high blood pressure, affects about one in five people in the United States. The cause of most cases of high blood pressure is not known. When the cause is not known, it is called essential or primary hypertension. Some cases result from other conditions, such as kidney disease and adrenal gland disorders. These cases are called secondary hypertension. A tendency toward high blood pressure may be inherited. High blood pressure is one of the major risk factors for development of a heart attack, stroke, heart failure, and kidney failure (Box 11-1). The rate of high blood pressure in children and adolescents is increasing. Because most people with high blood pressure have no symptoms at all, hypertension is sometimes called "the silent killer." The person may sometimes experience headaches, dizziness, and shortness of breath. Treatments for hypertension may include exercise, diet modification, avoiding tobacco products, and regular use of medication.

**MYOCARDIAL (my-o-KAR-dee-uhl) infarction,** known as heart attack, can begin with a buildup of fatty deposits in the lining of the coronary arteries that feed the heart muscle. If the delivery of oxygen is obstructed, a heart attack occurs. It can also result from blockage of the blood vessels to the heart by a clot called an embolus. The area of the heart that is deprived of oxygen quickly dies. The victim of a heart attack often experiences chest pain that may radiate to the jaw, neck, or jaw, or to the neck. If you think you are having a heart attack, have someone call 911 immediately. Remember: time is muscle. The sooner you get help, the less damage to heart muscle will occur.

**Case Study 11-3: You are trying to lower your blood pressure. While you are attending a party, you want to have a snack. Your choices are cheese dip with crackers, shrimp dip with crackers, and fresh vegetables with onion dip. Which should you eat?**

Answers to Case Studies are available on the Evolve website: http://evolve.elsevier.com/Gerdin

**Case Study 11-3: You are trying to lower your blood pressure. While you are attending a party, you want to have a snack. Your choices are cheese dip with crackers, shrimp dip with crackers, and fresh vegetables with onion dip. Which should you eat?**

Answers to Case Studies are available on the Evolve website: http://evolve.elsevier.com/Gerdin

**Myocardial (my-o-KAR-dee-uhl) infarction,** known as heart attack, can begin with a buildup of fatty deposits in the lining of the coronary arteries that feed the heart muscle. If the delivery of oxygen is obstructed, a heart attack occurs. It can also result from blockage of the blood vessels to the heart by a clot called an embolus. The area of the heart that is deprived of oxygen quickly dies. The victim of a heart attack often experiences chest pain that may radiate to the jaw, neck, or jaw, or to the neck. If you think you are having a heart attack, have someone call 911 immediately. Remember: time is muscle. The sooner you get help, the less damage to heart muscle will occur.
**BOX 11-1**

**Effects of High Blood Pressure**

- Atherosclerosis
- Arteriosclerosis
- Aneurysm

**Damage to the Heart**
- Coronary artery disease
- Enlarged left heart (hypertrophy)
- Heart failure

**Damage to the Brain**
- Transient ischemic attack
- Stroke
- Dementia
- Mild cognitive impairment

**Damage to the Kidneys**
- Kidney failure
- Kidney scarring (glomerulosclerosis)
- Kidney artery aneurysm

**Damage to the Eyes**
- Blood vessel damage (retinopathy)
- Fluid buildup under retina (choroidopathy)
- Nerve damage (optic neuropathy)

**FIGURE 11-10** Many lives can be saved using the automatic external defibrillator (AED) device. (From Patton KT, Thibodeau GA: Anatomy & physiology, ed 7, St. Louis, 2010, Mosby.)

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**BOX 11-2**

**ABCs of Preventing Heart Disease, Stroke, and Heart Attack**

- A—Avoid tobacco
- B—Become more active
- C—Choose good nutrition


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**BRAIN BYTE**

People who smoke or lack physical activity have twice the risk of having a heart attack than nonsmokers and the physically active.

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**CASE STUDY 11-4**

Your friend’s mother is overweight. She is complaining of her arm hurting, shortness of breath, and is perspiring. What should you do?

Answers to Case Studies are available on the Evolve website: http://evolve.elsevier.com/Gardin

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**Issues and Innovations**

**Heart Replacement**

The first heart transplant was performed in 1967. Each year, about 2,300 heart transplants are performed in the United States. Dr. William DeVries implanted the first artificial heart in a human being in 1982. The Jarvik-7 was connected to an external power source and pump. Along with newer versions of this type of device, the Jarvik-7 is considered a temporary bridge to stabilize a person waiting for a donor heart. Currently it takes more than 6 months to obtain a heart for transplant once the recommendation has been made for the procedure. Most transplant recipients live for more than a year and can return to work.

In May 1991 the Texas Heart Institute in Houston began using a portable heart-assist device to decrease the workload of the heart. Another development is the implant of an artificial heart that senses an abnormal electrical activity in the heart and delivers an immediate shock to resume a normal rhythm or prevent sudden death.

In July 2001 the AbioCor self-contained artificial heart was used for the first time by developer Dr. O. H. Frazier (Fig. 11-11). The first recipient, Mr. Robert Tools, lived 151 days with the heart. Five people were recipients of this heart by December 2001. The AbioCor clinical trial that Mr. Tools and the other recipients participated in was designed to test whether blood-thinning medications (anticoagulants), compression stockings, and elevation of the affected limb. Treatment may also include surgical removal of the clot or injection of dissolving drugs to remove the clot.

**Rheumatic** (ruh-MAT-ik) heart disease is a condition in which the heart muscle and valves are damaged by a recurrent bacterial infection that usually begins in the throat. The bacteria produce a toxin that causes inflammation and damage to the heart valves. Rheumatic fever is most common in children 5 to 15 years of age. The person experiences swelling of the joints, fever, shortness of breath, and chest pain (angina). The damaged heart valves may harden (sclerosis) and not close completely, allowing blood to leak through the valves. If the damage is great, affected valves may be replaced surgically. Treatment of strep throat with antibiotics such as penicillin can usually stop rheumatic fever from developing.

**Varicose** (va-RY-kuh-sus) veins is a common condition in which veins become enlarged and ineffective. This commonly occurs in the leg veins of people who stand for long periods. Congenitally malformed valves, pregnancy, or obesity may also cause varicose veins. The person may experience swelling, visible bluish veins, redness, and pain. Treatment includes increased exercise and elevation of the affected part. Support hose are often helpful. If the condition warrants, surgery can be performed to remove the veins.

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**FIGURE 11-11** A, AbioCor heart. B, Placement of AbioCor heart in the body. (Courtesy ABIOMED, Inc., Danvers, Mass.)
the AbioCor Implantable Replacement Heart could extend life for people with end-stage heart failure who have no other clinical option and provide them with a good quality of life. To be accepted into the trial, the patient had to be ineligible for heart transplantation and have a high probability of dying within 30 days.

In 2000 the U.S. Food and Drug Administration (FDA) approved the use of a total artificial heart designed to support life functions until a transplant becomes available. The SynCardia CardioWest Temporary Total Artificial Heart (TAH) may be used in patients with irreversible failure of the ventricles. The CardioWest TAH is the only FDA-approved artificial heart that can provide full circulation restoration in patients with this condition. The goal of the company is to develop smaller, more portable devices.

According to the Organ Procurement Transplantation Network, in 2006 more than 3000 people were on a waiting list for a heart transplant. The American Heart Association reports that a new name is added to the national organ transplant list every 16 minutes.

Cholesterol Controversy

Cholesterol, which is found in all animal cells, is a wadlike substance used in the body to make cell membranes, hormones, and vitamin D. The liver makes enough cholesterol for all these needs. Cholesterol does not mix in water, so it is carried in the blood in proteins (lipoprotein). Cholesterol is found in both low-density lipoprotein (LDL) and high-density lipoprotein (HDL) forms. The HDL form takes cholesterol to the liver, whereas the LDL form blocks the arteries.

Elevated blood cholesterol is one of the major risk factors for development of heart disease. Triglycerides or fats carried in the blood from food are also measured. The World Health Organization estimates that more than 50% of heart attacks and almost 20% of strokes are linked to high cholesterol.

Guidelines given to the public for the recommended types and amount of cholesterol have been confusing and disputed in the past. In 2004 the National Cholesterol Education Program updated guidelines on cholesterol management. Currently for adults older than 20 years, the emphasis is placed on the ratio of LDL to HDL in the blood as well as an overall value of less than 200 mg/dL (milligrams of cholesterol per deciliter of blood). The HDL portion should be greater than 40 mg/dL. The LDL levels should be less than 130 mg/dL. A lipoprotein profile every 5 years or more often is recommended.

Harvard researchers have studied the link between fat in the diet and cholesterol blood levels over the past 20 years. They concluded that the type of fat in the diet, not the amount, changes the cholesterol level.

Fats that were determined to lower LDL and raise HDL were monounsaturated and polyunsaturated fats such as olive, canola oil, avocado, fish, and most nuts. These fats are usually liquid at room temperature. Fats that raise both LDL and HDL are saturated fats, including whole milk, butter, cheese, red meat, chocolate, and coconut oil. These fats are generally solid at room temperature. Trans-fats, which are solid or semisolid at room temperature, raise the LDL and lower the HDL. They are considered the worst kind of fat. Foods containing trans-fat include most margarines, vegetable oils, shortening, deep-fried, and most fast foods. The Harvard researchers concluded that the amount of unsaturated fat in the diet does not necessarily raise blood cholesterol. In fact, replacing other calories with unsaturated fats such as fish may lower the risk for heart disease. They recommend limiting intake of saturated fats and eliminating trans-fats completely.

Losing excess weight, exercising, and not smoking will increase the overall HDL value. A diet with low-cholesterol foods such as fruits and vegetables is the best method for reducing the values. Some medications are used to reduce the level of cholesterol in the blood. Recently claims have been made that vitamins that prevent the oxidation (chemical breakdown) of cholesterol help prevent heart disease. However, this type of treatment is not recommended because of the harmful effects of large doses of these vitamins. Some research done in England has indicated that smaller, more frequent meals lower the amount of LDL produced.

Review Questions

1. Describe the four functions of the cardiovascular system.
2. Explain the differences in structure of the arteries, veins, and capillaries.
3. Identify the location of the following parts of the Cardiovascular system:
   - Carotid artery
   - Mitral valve
   - Radial artery
   - Endocardium
   - Inferior vena cava
   - Pericardium
   - Sinoatrial node
   - Percarnary artery
   - Left ventricle
4. Explain the action of the heart during systolic and diastolic contractions.

Critical Thinking

1. Investigate and compare the cost of at least three tests used in diagnosing disorders of the cardiovascular system.
2. Investigate the function of at least five common medications used in treatment of the cardiovascular system.
3. List at least five occupations involved in the health care of cardiovascular system disorders.