

Cardiovascular System

CHAPTER

8

Chapter Outline

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- Chart note: Acute myocardial infarction
- Operative report: Right temporal artery biopsy

Objectives

Upon completion of this chapter, you will be able to:

- Locate and describe the structures of the cardiovascular system.
- Describe the functional relationship between the cardiovascular system and other body systems.
- Identify, pronounce, spell, and build words related to the cardiovascular system.
- Describe pathological conditions, diagnostic and therapeutic procedures, and other terms related to the cardiovascular system.
- Explain pharmacology related to the treatment of cardiovascular disorders.
- Demonstrate your knowledge of this chapter by completing the learning and medical record activities.



Anatomy and Physiology

The cardiovascular (CV) system is composed of the heart and blood vessels. The heart is a hollow, muscular organ lying in the mediastinum, the center of the thoracic cavity between the lungs. The pumping action of the heart propels blood containing oxygen, nutrients, and other vital products from the heart to body cells through a vast network of blood vessels called *arteries*. Arteries branch into smaller vessels until they become microscopic vessels called *capillaries*. It is at the capillary level that exchange of products occurs between body cells and blood. Capillaries merge to form larger blood vessels called *venules*, which then combine to form *veins*, the vessels that return blood to the heart to begin the cycle again. Millions of body cells rely on the cardiovascular system for their survival. When this transportation system fails, life at the cellular level is not possible and, ultimately, the organism will die.

Vascular System

Three major types of vessels—(1) **artery**, (2) **capillary**, and (3) **vein**—carry blood throughout the body. (See Figure 8–1.) Each type of vessel differs in structure depending on its function.

Arteries

Arteries carry blood from the heart to all cells of the body. Because blood is propelled through the arteries by the pumping action of the heart, the walls of the arteries must be strong and flexible enough to withstand the surge of blood that results from each contraction of the heart.

The walls of large arteries have three layers to provide toughness and elasticity. The (4) **tunica externa** is the outer coat composed of connective tissue that provides strength and flexibility. The (5) **tunica media** is the middle layer composed of smooth muscle. Depending on the needs of the body, this muscle can alter the size of the (7) **lumen**

Anatomy and Physiology Key Terms

This section introduces important terms and their definitions and pronunciation.

Term	Definition
autonomic nervous system (ANS) aw-tō-NŌM-ĭk NĒR-vēs	Portion of the nervous system that regulates involuntary actions, such as heart rate, digestion, and peristalsis
leaflet	Thin, flattened structure; term used to describe the leaf-shaped structures that compose a heart valve
lumen LŪ-mĕn	Tubular space or channel within any organ or structure of the body; space within an artery, vein, intestine, or tube
regurgitation rē-gŭr-jĭ-TĀ-shŭn	Backflow or ejecting of contents through an opening
sphincter SFĪNGK-tĕr	Circular muscle found in a tubular structure or hollow organ that constricts or dilates to regulate passage of substances through its opening
vasoconstriction vās-ō-kŏn-STRĪK-shŭn	Narrowing of the lumen of a blood vessel that limits blood flow, usually as a result of diseases, medications, or physiological processes
vasodilation vās-ō-dĭ-LĀ-shŭn	Widening of the lumen of a blood vessel caused by the relaxing of the muscles of the vascular walls
viscosity vĭs-KŌS-ĭ-tĕ	State of being sticky or gummy <i>A solution that has high viscosity is relatively thick and flows slowly.</i>
Pronunciation Help	Long Sound ā—rate ē—rebirth ĩ—isle ō—over ū—unite Short Sound ă—alone ě—ever ĭ—it ȏ—not ŭ—cut

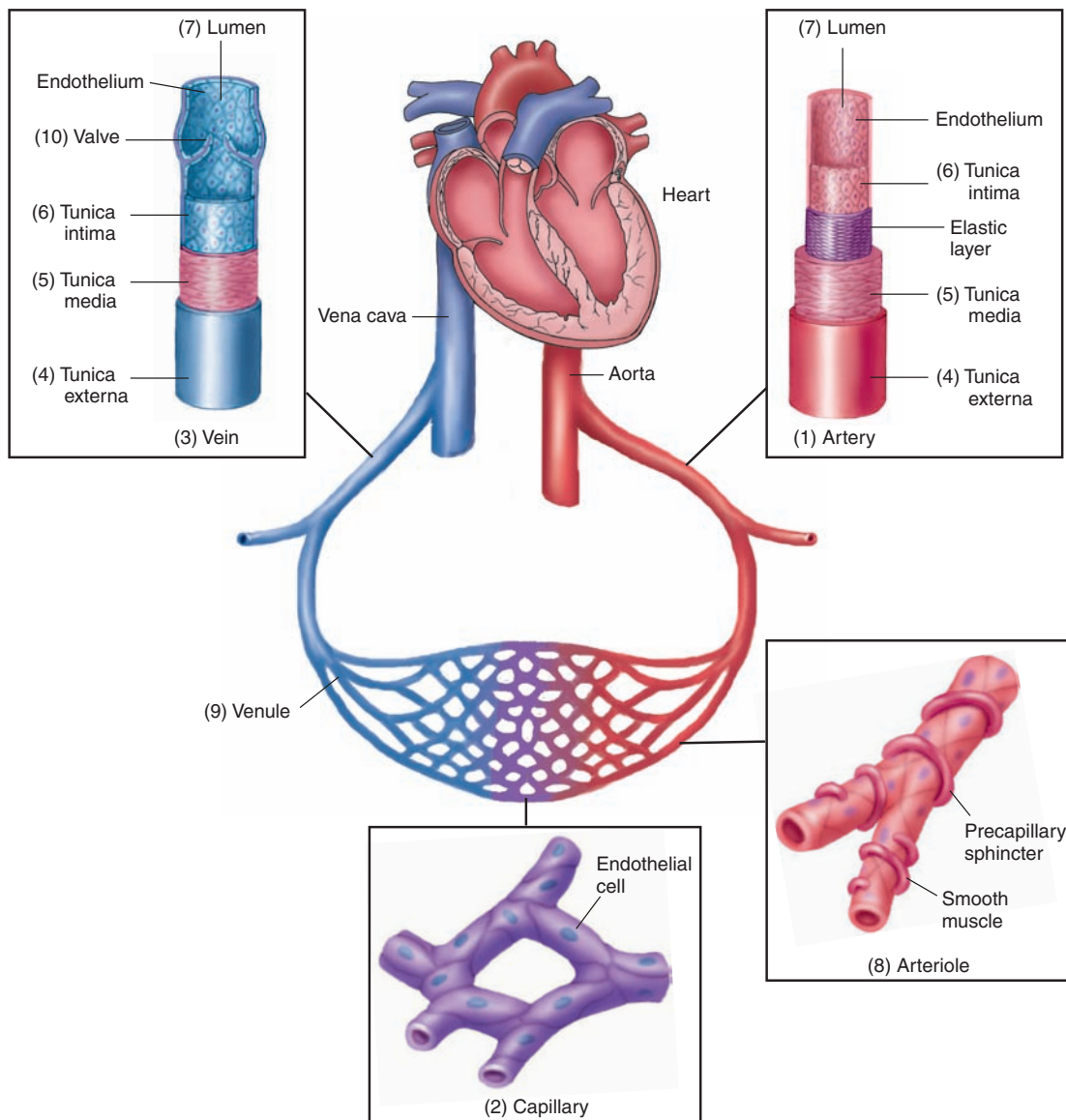


Figure 8-1. Vascular structures.

of the vessel. When it contracts, it causes **vasoconstriction**, resulting in decreased blood flow. When it relaxes, it causes **vasodilation**, resulting in increase blood flow. The (6) **tunica intima** is the thin, inner lining of the lumen of the vessel, composed of endothelial cells that provide a smooth surface on the inside of the vessel.

The surge of blood felt in the arteries when blood is pumped from the heart is referred to as a **pulse**. Because of the pressure against arterial walls associated with the pumping action of the heart, a cut or severed artery may lead to profuse bleeding.

Arterial blood (except for that found in the pulmonary artery) contains a high concentration of oxygen (**oxygenated**) and appears bright red in color. Oxygenated blood travels to smaller arteries

called (8) **arterioles** and, finally, to the smallest vessels, the capillaries.

Capillaries

Capillaries are microscopic vessels that join the arterial system with the venous system. Although they seem like the most insignificant of the three vessel types owing to their microscopic size, they are actually the most important because of their function. Because capillary walls are composed of only a single layer of endothelial cells, they are very thin. This thinness enables the exchange of water, respiratory gases, macromolecules, metabolites, and wastes between the blood and adjacent cells. The vast number of capillaries branching from arterioles causes blood to flow very slowly,

providing sufficient time for exchange of necessary substances.

Blood flow through the highly branched capillary system is partially regulated by the contraction of smooth muscle precapillary **sphincters** that lead into the capillary bed. When tissues require more blood, these sphincters open; when less blood is required, they close. Once the exchange of products is complete, blood enters the venous system for its return cycle to the heart.

Veins

Veins return blood to the heart. They are formed from smaller vessels called (9) **venules** that develop from the union of capillaries. Because the extensive network of capillaries absorbs the propelling pressure exerted by the heart, veins use other methods to return blood to the heart, including:

- skeletal muscle contraction
- gravity
- respiratory activity
- valves.

The (10) **valves** are small structures within veins that prevent the backflow of blood. Valves are found mainly in the extremities and are especially important for returning blood from the legs to the heart because blood must travel a long distance against the force of gravity to reach the heart from the legs. Large veins, especially in the abdomen, contain smooth muscle that propels blood toward the heart by peristalsis.

Blood carried in veins (except for the blood in the pulmonary veins) contains a low concentration of oxygen (**deoxygenated**) with a corresponding high concentration of carbon dioxide. Deoxygenated blood takes on a characteristic purple color. Blood continuously circulates from the heart to the lungs so that carbon dioxide can be exchanged for oxygen.

Heart

The **heart** is a muscular pump that propels blood to entire body through a closed vascular system. It is found in a sac called the *pericardium*. The heart is composed of three distinct tissue layers:

- **endocardium**, a serous membrane that lines the four chambers of the heart and its valves and is continuous with the endothelium of the arteries and veins
- **myocardium**, the muscular layer of the heart
- **epicardium**, the outermost layer of the heart.

The heart is divided into four chambers. (See Figure 8–2.) The two upper chambers, the (1) **right**

atrium and (2) **left atrium**, collect blood. The two lower chambers, the (3) **right ventricle** and (4) **left ventricle**, pump blood from the heart. The right ventricle pumps blood to the lungs (**pulmonary circulation**) for oxygenation, and the left ventricle pumps oxygenated blood to the entire body (**systemic circulation**).

Deoxygenated blood from the body returns to the right atrium by way of two large veins: the (5) **superior vena cava**, which collects and carries blood from the upper body; and the (6) **inferior vena cava**, which collects and carries blood from the lower body. From the right atrium, blood passes through the (7) **tricuspid valve**, consisting of three **leaflets**, to the right ventricle. When the heart contracts, blood leaves the right ventricle by way of the (8) **left pulmonary artery** and (9) **right pulmonary artery** and travels to the lungs. During contraction of the ventricle, the tricuspid valve closes to prevent a backflow of blood to the right atrium. The (10) **pulmonic valve** (or *pulmonary semilunar valve*) prevents **regurgitation** of blood into the right ventricle from the pulmonary artery. In the lungs, the pulmonary artery branches into millions of capillaries, each lying close to an alveolus. Here, carbon dioxide in the blood is exchanged for oxygen that has been drawn into the lungs during inhalation.

Pulmonary capillaries unite to form four pulmonary veins—two (11) **right pulmonary veins** and two (12) **left pulmonary veins**. These vessels carry oxygenated blood back to the heart. They deposit blood in the left atrium. From there, blood passes through the (13) **mitral (bicuspid) valve**, consisting of two leaflets to the left ventricle. Upon contraction of the ventricles, the oxygenated blood leaves the left ventricle through the largest artery of the body, the (14) **aorta**. The aorta contains the (15) **aortic semilunar valve (aortic valve)** that permits blood to flow in only one direction—from the left ventricle to the aorta. The aorta branches into many smaller arteries that carry blood to all parts of the body. Some arteries derive their names from the organs or areas of the body they vascularize. For example, the splenic artery vascularizes the spleen and the renal arteries vascularize the kidneys.

It is important to understand that oxygen in the blood passing through the chambers of the heart cannot be used by the myocardium as a source of oxygen and nutrients. Instead, an arterial system composed of the coronary arteries branches from the aorta and provides the heart with its own blood supply. The artery vascularizing the right side of the heart is the (16) **right coronary artery**. The artery vascularizing the left side of the heart is the (17) **left coronary artery**. The left coronary artery

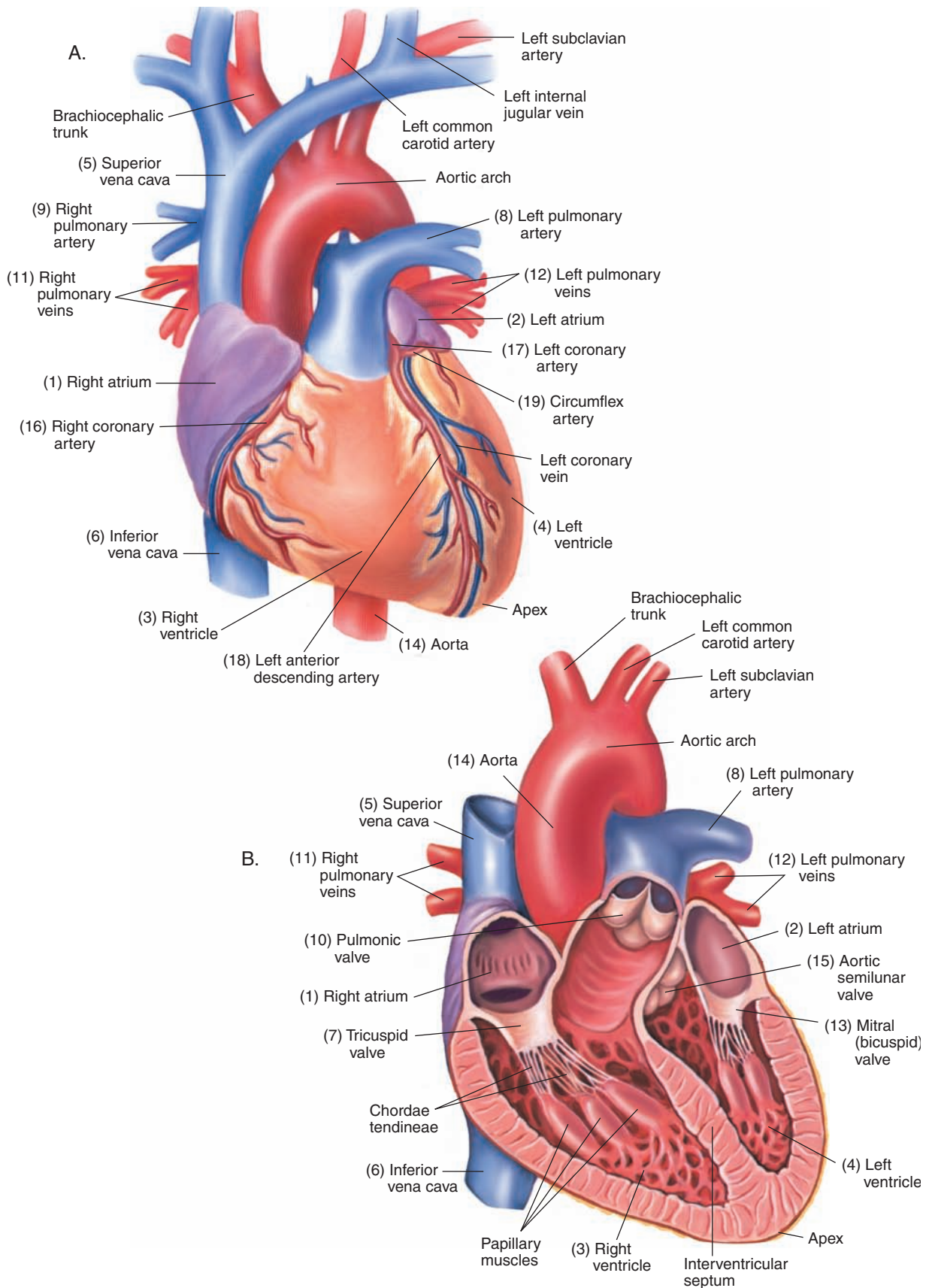


Figure 8-2. Structures of the heart. (A) Anterior view of the heart. (B) Frontal section of the heart.

divides into the (18) **left anterior descending artery** and the (19) **circumflex artery**. If blood flow in the coronary arteries is diminished, damage to the heart muscle may result. When severe damage occurs, part of the heart muscle may die.

Conduction System of the Heart

Within the heart, a specialized cardiac tissue known as *conduction tissue* has the sole function of initiating and spreading contraction impulses. (See Figure 8–3.) This tissue consists of four masses of highly specialized cells that possess characteristics of nervous and cardiac tissue:

- sinoatrial (SA) node
- atrioventricular (AV) node
- bundle of His (AV bundle)
- Purkinje fibers.

The (1) **sinoatrial (SA) node** is located in the upper portion of the right atrium and possesses its own intrinsic rhythm. Without being stimulated by external nerves, it has the ability to initiate and propagate each heartbeat, thereby setting the basic pace for the cardiac rate. For this reason, the SA node is commonly known as the *pacemaker* of the heart. Cardiac rate may be altered by impulses from the **autonomic nervous system**. Such an arrangement allows outside influences to accelerate or decelerate heart rate. For example, the heart beats more quickly during physical exertion and more slowly during rest. Each electrical impulse discharged by the SA node is transmitted to the (2) **atrioventricular (AV) node**, causing the atria to contract. The AV node is located at the base of the right atrium. From this point, a tract of con-

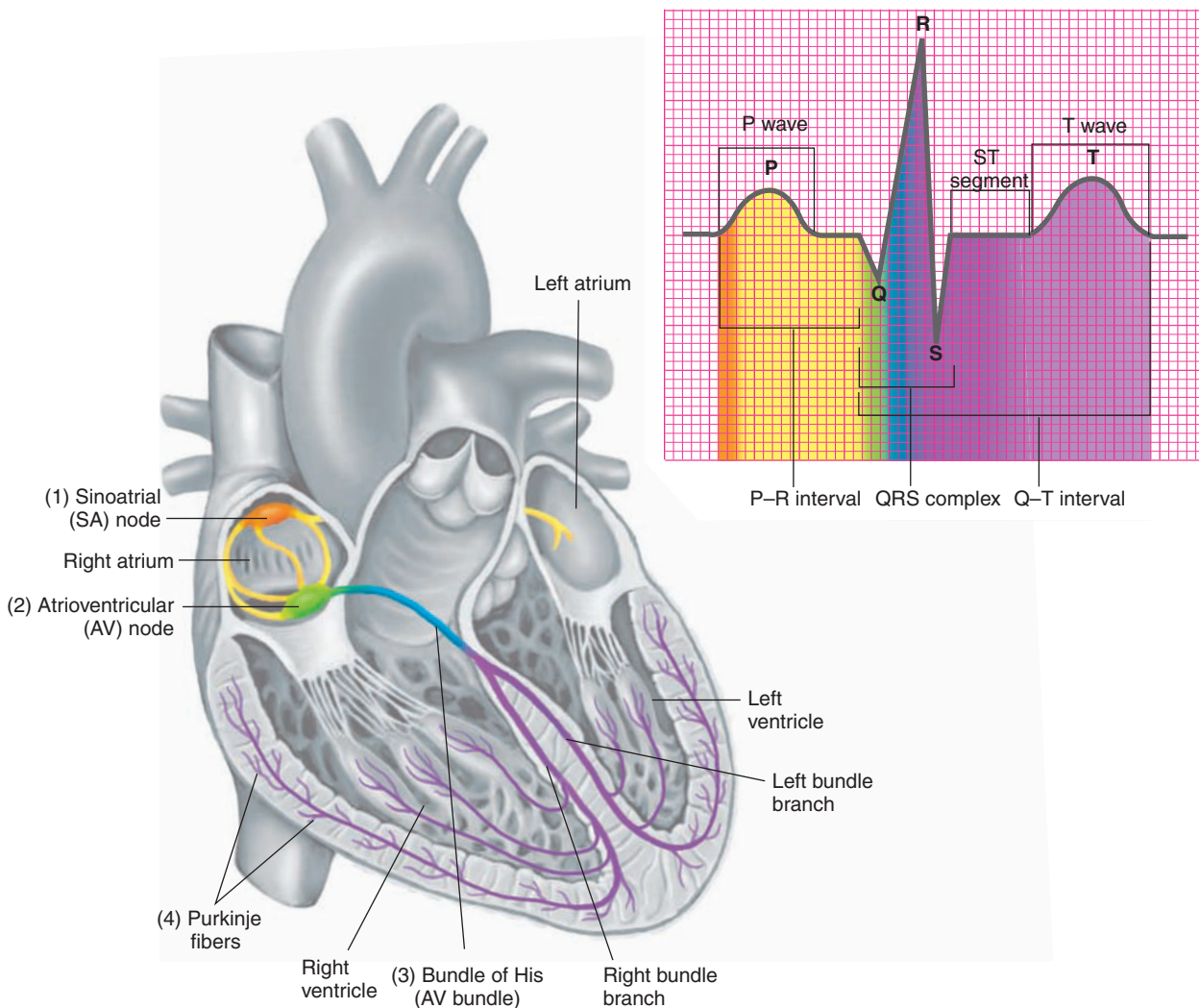


Figure 8-3. Conduction system.

duction fibers called the (3) **bundle of His** (AV bundle), composed of a right and left branch, relays the impulse to the (4) **Purkinje fibers**. These fibers extend up the ventricle walls. The Purkinje fibers transmit the impulse to the right and left ventricles, causing them to contract. Blood is now forced from the heart through the pulmonary artery and aorta. Thus, the sequence of the four structures responsible for conduction of a contraction impulse is:

SA node → AV node → bundle of His →
Purkinje fibers

Impulse transmission through the conduction system generates weak electrical currents that can be detected on the surface of the body. An instrument called an *electrocardiograph* records these electrical impulses, using a needle, or stylus, that records the activity on graph paper. The needle deflection of the electrocardiograph produces waves or peaks designated by the letters P, Q, R, S, and T, each of which is associated with a specific electrical event:

- The **P wave** is the depolarization (contraction) of the atria.
- The **QRS complex** is the depolarization (contraction) of the ventricles.
- The **T wave**, which appears a short time later, is the repolarization (recovery) of the ventricles.

Blood Pressure

Blood pressure (BP) measures the force of blood against the arterial walls during two phases of a heartbeat: the contraction phase (**systole**) when the blood is forced out of the heart, and the relaxation phase (**diastole**) when the ventricles are filling with blood. Systole produces the maximum force; diastole, the weakest. These measurements are recorded as two figures separated by a diagonal line. Systolic pressure is given first, followed by diastolic pressure. For instance, a blood pressure of 120/80 mm Hg means a systolic pressure of 120 with a diastolic pressure of 80. A consistently elevated blood pressure is

called *hypertension*; decreased blood pressure is called *hypotension*.

Several factors influence blood pressure:

- resistance of blood flow in blood vessels
- pumping action of the heart
- **viscosity**, or thickness, of blood
- elasticity of arteries
- quantity of blood in the vascular system.

Fetal Circulation

Blood circulation through a fetus is, by necessity, different from that of a newborn infant. The process of gas exchange, the procurement of nutrients, and the elimination of metabolic wastes occur in the placenta. This remarkable structure delivers nutrients and oxygen from the mother to the fetus and removes waste products from the fetus and delivers them to the mother for disposal. The placenta develops during pregnancy and is expelled after the delivery of the infant.

There are several important structures involved in fetal circulation. (See Figure 8–4.) The (1) **umbilical cord**, containing (2) two **arteries**, carries deoxygenated blood from the fetus to the (3) **placenta**. After oxygenation in the placenta, blood returns to the fetus via the (4) **umbilical vein**. Most of the blood in the umbilical vein enters the (5) **inferior vena cava** through the (6) **ductus venosus**, where it is delivered to the (7) **right atrium**. Some of this blood passes to the (8) **right ventricle**; however, most of it passes to the (9) **left atrium** through a small opening in the atrial septum called the (10) **foramen ovale**, which closes shortly after birth. From the left atrium, blood enters the (11) **left ventricle** and finally exits the heart through the aorta, where it travels to the head and upper extremities. Because fetal lungs are nonfunctional, most of the blood in the pulmonary arteries is shunted through a connecting vessel called the (12) **ductus arteriosus** to the aorta. Immediately after birth, the ductus arteriosus withers and closes off. As circulation increases in the neonate, the increase of blood flow to the right atrium forces the foramen ovale to close. Normal circulation is now fully established.

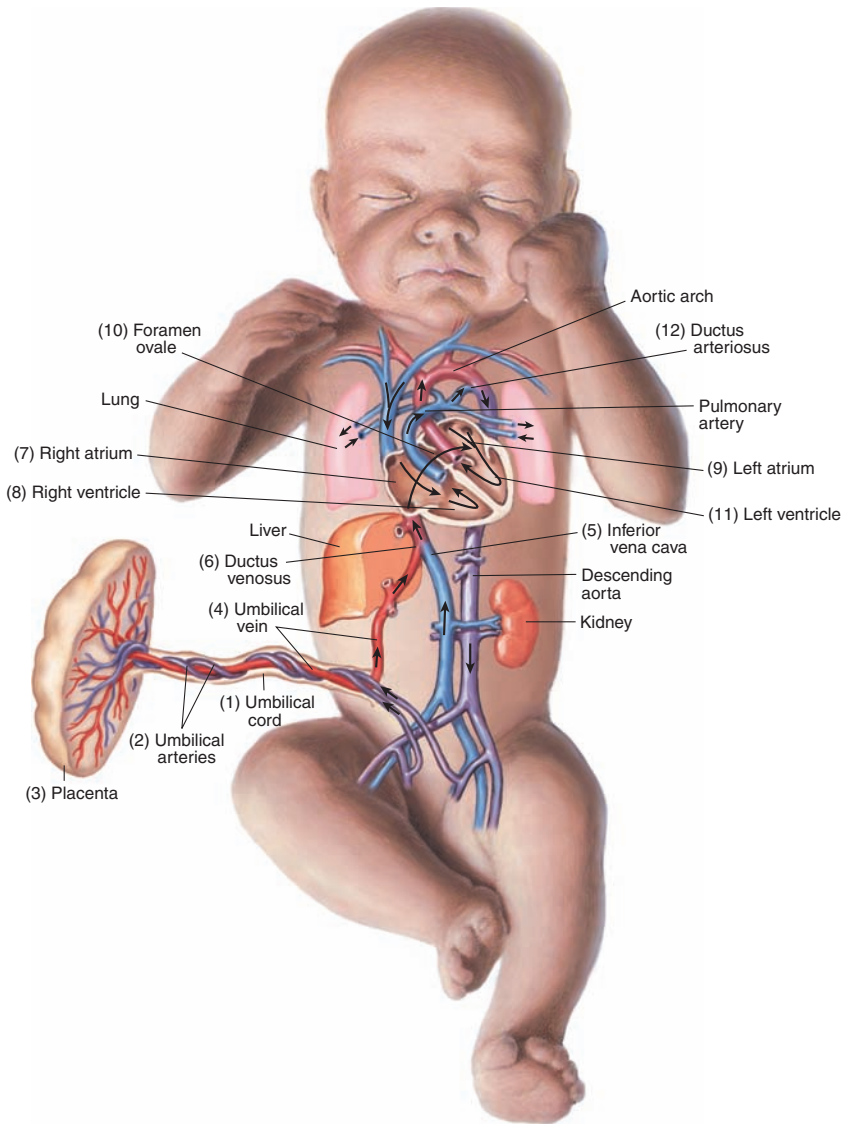


Figure 8-4. Fetal circulation.

Connecting Body Systems-Cardiovascular System

The main function of the cardiovascular system is to provide a network of vessels through which blood is pumped by the heart to all body cells. Specific functional relationships between the cardiovascular system and other body systems are discussed below.



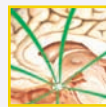
Blood, lymph, and immune

- Cardiovascular system transports the products of the immune system.



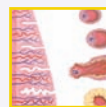
Digestive

- Cardiovascular system delivers hormones that affect glandular activity of the digestive tract.
- Cardiovascular system provides vasculature to the walls of the small intestine for absorption of nutrients.



Endocrine

- Cardiovascular system delivers oxygen and nutrients to endocrine glands.
- Cardiovascular system transports hormones from glands to target organs.

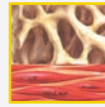


Female reproductive

- Cardiovascular system transports hormones that regulate the menstrual cycle.
- Cardiovascular system influences the normal function of sex organs, especially erectile tissue.

Connecting Body Systems-Cardiovascular System—cont'd

- Cardiovascular system provides the vessels of the placenta during pregnancy for the exchange of nutrients and waste products.



Genitourinary

- Cardiovascular system transports reproductive hormones.
- Cardiovascular system influences the normal function of sex organs, especially erectile tissue.
- Cardiovascular system delivers dissolved wastes to the kidneys for excretion in urine.



Integumentary

- Cardiovascular system provides blood vessels in the skin to regulate body temperature
- Cardiovascular system transports clotting factors to the skin to control bleeding.
- Cardiovascular system carries immune agents to sites of skin wounds and infections.

Musculoskeletal

- Cardiovascular system removes heat and waste products generated by muscle contraction.
- Cardiovascular system delivers oxygen for energy to sustain muscle contraction.
- Cardiovascular system delivers calcium and nutrients and removes metabolic wastes from skeletal structures.
- Cardiovascular system delivers hormones that regulate skeletal growth.



Nervous

- Cardiovascular system carries electrolytes for transmission of electrical impulses.



Respiratory

- Cardiovascular system transports oxygen and carbon dioxide between lungs and tissues



It is time to review cardiovascular structures by completing Learning Activity 8–1.

Medical Word Elements

This section introduces combining forms, suffixes, and prefixes related to the cardiovascular system. Word analyses are also provided.

Element	Meaning	Word Analysis
Combining Forms		
aneurysm/o	widened blood vessel	aneurysm/o /rrhaphy (ăn-ŭ-rĭz-MOR-ă-fĕ): suture of an aneurysm -rrhaphy: suture
angi/o	vessel (usually blood or lymph)	angi/o /plasty (ĂN-jĕ-ō-plās-tĕ): surgical repair of a vessel -plasty: surgical repair <i>Angioplasty includes any endovascular procedure that reopens narrowed blood vessels and restores blood flow.</i>
vascul/o		vascul/itis (văs-kŭ-LĪ-tĭs): inflammation of (blood) vessels -itis: inflammation
aort/o	aorta	aort/o /stenosis (ă-or-tō-stĕ-NŌ-sĭs): narrowing of the aorta -stenosis: narrowing, stricture
arteri/o	artery	arteri/o /rrhexis (ăr-tĕ-rĕ-ō-RĚK-sĭs): rupture of an artery -rrhexis: rupture

(continued)

Medical Word Elements—cont'd		
Element	Meaning	Word Analysis
arteriol/o	arteriole	arteriol/itis (ār-tēr-ē-ō-LĪ-tīs): inflammation of an arteriole -itis: inflammation
atri/o	atrium	atri/o/megaly (ā-trē-ō-MĚG-ā-lē): enlargement of the atrium -megaly: enlargement
ather/o	fatty plaque	ather/oma (āth-ēr-Ō-mā): tumor of fatty plaque -oma: tumor <i>Atheromas are formed when fatty plaque builds up on the inner lining of arterial walls. As calcium and other minerals are absorbed by plaque, the vessel hardens.</i>
cardi/o	heart	cardi/o/megaly (kār-dē-ō-MĚG-ā-lē): enlargement of the heart -megaly: enlargement
electr/o	electricity	electr/o/cardi/o/gram (ē-lĕk-trō-KĀR-dē-ō-grām): record of the electrical (impulses) of the heart cardi/o: heart -gram: record, recording <i>An electrocardiogram is commonly used to diagnose abnormalities of the heart.</i>
embol/o	embolus (plug)	embol/ectomy (ēm-bō-LĚK-tō-mē): removal of an embolus -ectomy: excision, removal <i>An embolectomy is the removal of a clot or other foreign material from a blood vessel. Most emboli are blood clots (thrombi) that have been transported from a distant vessel by the blood.</i>
hemangi/o	blood vessel	hemangi/oma (hē-mān-jē-Ō-mā): tumor of blood vessels -oma: tumor <i>Infantile hemangiomas are also called birthmarks. They are not considered malignant and usually disappear over time.</i>
my/o	muscle	my/o/cardi/al (mī-ō-KĀR-dē-āl): pertaining to heart muscle cardi: heart -al: pertaining to, relating to
phleb/o	vein	phleb/ectasis (flĕ-BĚK-tā-sīs): expansion of a vein -ectasis: dilation, expansion
ven/o		ven/o/stasis (vē-nō-STĀ-sīs): standing still of (blood in a) vein; also called <i>phlebostasis</i> -stasis: standing still
scler/o	hardening; sclera (white of eye)	arteri/o/scler/osis (ār-tēr-ē-ō-sklĕ-RŌ-sīs): abnormal condition of hardening of the artery arteri/o: artery -osis: abnormal condition; increase (used primarily with blood cells) <i>The most common cause of arteriosclerosis is the presence of an atheroma in the vessel. Other common causes include smoking, diabetes, high blood pressure, obesity, and familial tendency.</i>

Medical Word Elements—cont'd		
Element	Meaning	Word Analysis
sept/o	septum	sept/o /stomy (sĕp-TŌS-tō-mĕ): forming an opening in a septum <i>-stomy</i> : forming an opening (mouth) <i>Septostomy is a temporary procedure performed to increase systemic oxygenation in infants with congenital heart defects until corrective surgery can be performed.</i>
sphygm/o	pulse	sphygm/o id (SFĪG-moyd): resembling a pulse <i>-oid</i> : resembling
sten/o	narrowing, stricture	sten/o /tic (stĕ-NŌT-ĭk): pertaining to a narrowing or stricture <i>-tic</i> : pertaining to
thromb/o	blood clot	thromb/o /lysis (thrŏm-BŎL-ĭ-sĭs): destruction of a blood clot <i>-lysis</i> : separation; destruction; loosening <i>In thrombolysis, enzymes that destroy blood clots are infused into the occluded vessel.</i>
ventricul/o	ventricle (of the heart or brain)	ventricul /ar (vĕn-TRĪK-ŭ-lār): pertaining to a ventricle (chamber of the heart or brain) <i>-ar</i> : pertaining to
Suffixes		
-gram	record, writing	arteri/o / gram (ār-TĒ-rĕ-ō-grām): record of an artery <i>arteri/o</i> : artery <i>An arteriogram is used to visualize almost any artery, including those of the heart, head, kidneys, lungs, and other organs.</i>
-graph	instrument for recording	electr/o / cardi/o / graph (ĕ-lĕk-trŏ-KĀR-dĕ-ō-grāf): instrument for recording electrical (activity) of the heart <i>electr/o</i> : electricity <i>cardi/o</i> : heart
-graphy	process of recording	angi/o / graphy (ān-jĕ-ŌG-rā-fĕ): process of recording (an image of) a vessel <i>angi/o</i> : vessel (usually blood or lymph) <i>Angiography is commonly used to identify atherosclerosis and diagnose heart and peripheral vascular disease.</i>
-sphyxia	pulse	a / sphyxia (ās-FĪK-sĕ-ā): without a pulse; also called <i>suffocation</i> <i>a-</i> : without, not <i>The term asphyxia usually refers to a death caused by anoxia.</i>
-stenosis	narrowing, stricture	aort/o / stenosis (ā-or-tŏ-stĕ-NŌ-sĭs): narrowing of the aorta <i>aort/o</i> : aorta
Prefixes		
brady-	slow	brady /cardia (brād-ĕ-KĀR-dĕ-ā): slow heart (beat) <i>-cardia</i> : heart condition <i>Bradycardia is usually defined as a heart rate less than 55 beats per minute when resting.</i>
endo-	in, within	endo /vascul/ar (ĕn-dŏ-VĀS-kŭ-lār): relating to (the area) within a vessel <i>vascul</i> : vessel <i>-ar</i> : pertaining to

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Medical Word Elements—cont'd		
Element	Meaning	Word Analysis
extra-	outside	extra/vascul/ar (ĕks-tră-VĂS-kū-lăr): relating to the (area) outside a vessel <i>vascul</i> : vessel <i>-ar</i> : pertaining to
peri-	around	peri/cardi/al (pĕr-ĭ-KĂR-dĕ-ăl): pertaining to (the area) around the heart <i>cardi</i> : heart <i>-al</i> : pertaining to, relating to
tachy	rapid	tachy/cardia (tăk-ĕ-KĂR-dĕ-ă): rapid heart (beat) <i>-cardia</i> : heart condition <i>Tachycardia is defined as a heart rate greater than 100 beats per minute.</i>
trans-	across	trans/sept/al (trăns-SĔP-tăl): across the septum <i>sept</i> : septum <i>-al</i> : pertaining to



It is time to review medical word elements by completing Learning Activity 8–2. For audio pronunciations of the above-listed key terms, you can visit www.davisplus.fadavis.com/gyls/systems to download this chapter's Listen and Learn! exercises or use the book's audio CD (if included).

Pathology

Many cardiac disorders, especially coronary artery disease, and valvular disorders are associated with a genetic predisposition. Thus, a complete history as well as a physical examination is essential in the diagnosis of cardiovascular disease. Although some of the most serious cardiovascular diseases have few signs and symptoms, when they occur they may include chest pain (**angina**), palpitations, breathing difficulties (**dyspnea**), cardiac irregularities (**arrhythmias**) and loss of consciousness (**syncope**). The location, duration, pattern of radiation, and severity of pain are important qualities indifferentiating the various forms of cardiovascular disease and are sometimes characteristic of specific disorders. Because of the general nature of the signs and symptoms of cardiovascular disorders, invasive and noninvasive tests are usually required to confirm or rule out a suspected disease.

For diagnosis, treatment, and management of cardiovascular disorders, the medical services of a specialist may be warranted. **Cardiology** is the medical specialty concerned with disorders of the cardiovascular system. The physician who treats these disorders is called a *cardiologist*.

Arteriosclerosis

Arteriosclerosis is a hardening of arterial walls that causes them to become thickened and brittle. This hardening results from a build-up of a plaquelike substance composed of cholesterol, lipids, and cellular debris (**atheroma**). Over time, it builds up on the inside lining (**tunica intima**) of the arterial walls. Eventually, the plaque hardens (**atherosclerosis**), causing the vessel to lose elasticity. (See Figure 8–5.) The lumen narrows as the plaque becomes larger. After a while, it becomes difficult for blood to pass through the blocked areas. Tissues distal to the occlusion become ischemic. In many instances, blood hemorrhages into the plaque and forms a clot (**thrombus**) that may dislodge. When a thrombus travels through the vascular system it is called an *embolus* (plural, *emboli*). Emboli in venous circulation may cause death. Emboli in arterial circulation commonly lodge in a capillary bed and cause localized tissue death (**infarct**). Sometimes plaque weakens the vessel wall to such an extent that it forms a bulge (**aneurysm**) that may rupture. (See Figure 8–6.)

Arteriosclerosis usually affects large- or medium-sized arteries, including the abdominal aorta; the

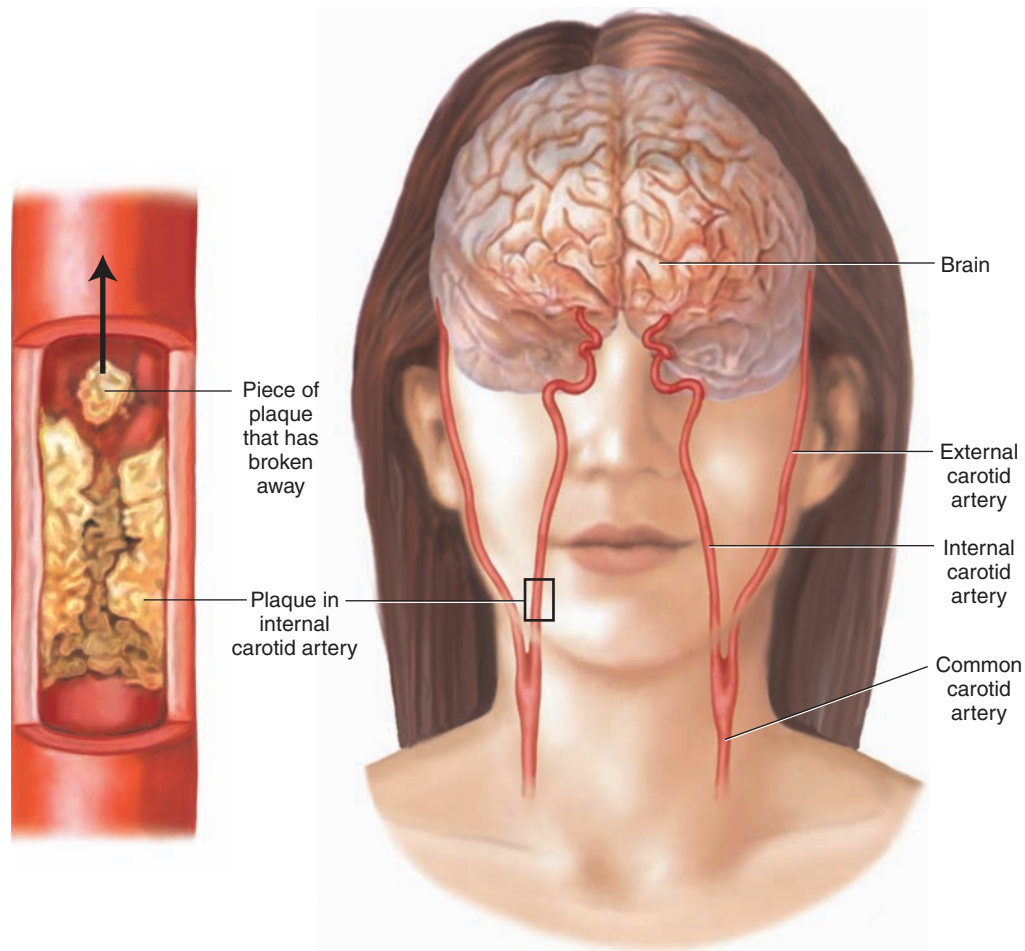


Figure 8-5. Atherosclerosis of the internal carotid artery.

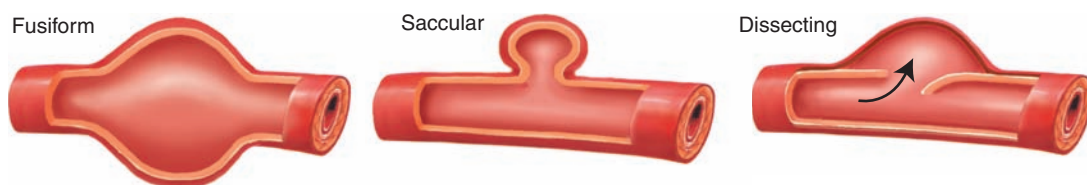


Figure 8-6. Aneurysms.

coronary, cerebral, and renal arteries; and major arteries of the legs (**femoral arteries**). One of the major risk factors for developing arteriosclerosis is an elevated cholesterol level (**hypercholesterolemia**). Other major risk factors include age, family history, smoking, hypertension, and diabetes.

Treatment for arteriosclerosis varies depending on the location and symptoms. In one method, occluding material and plaque are removed from the innermost layer of the artery (**endarterectomy**). (See Figure 8-7.) In this procedure, the surgeon opens the site and removes the plaque, there-

by resuming normal blood flow. Physicians commonly use endarterectomy to treat carotid artery disease, peripheral arterial disease, and diseases of the renal artery and aortic arch.

Coronary Artery Disease

In order for the heart to function effectively, it must receive an uninterrupted supply of blood. This blood is delivered to the heart muscle by way of the coronary arteries. Failure of the coronary arteries to deliver an adequate supply of blood to

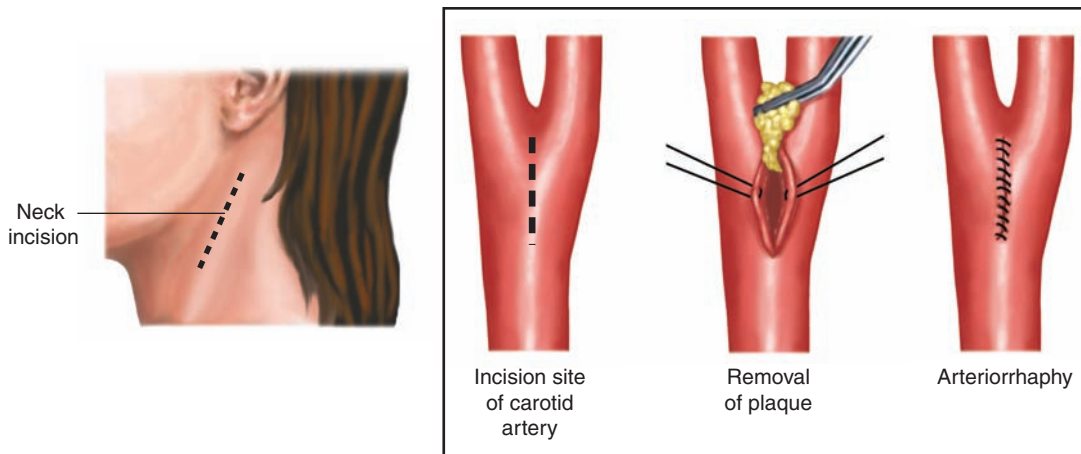


Figure 8-7. Endarterectomy of the common carotid artery.

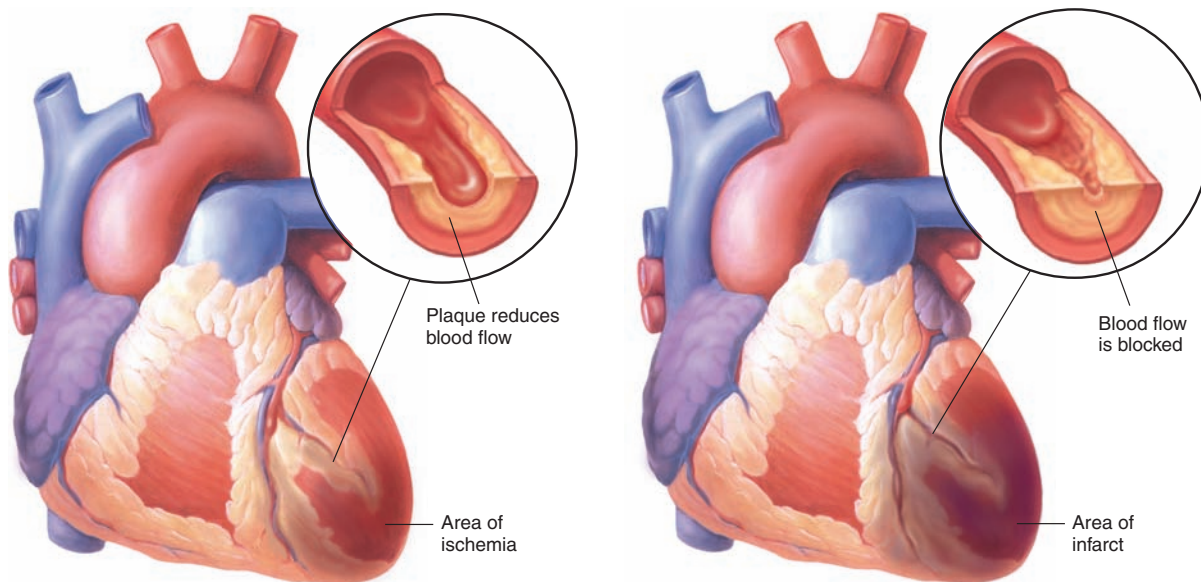


Figure 8-8. Occlusions. (A) Partial occlusion. (B) Total occlusion.

the myocardium is called *coronary artery disease (CAD)*. Its major cause is the accumulation of plaque which causes the walls of the artery to harden (*arteriosclerosis*). With partial occlusion, localized areas of the heart experience oxygen deficiency (*ischemia*). When the occlusion is total or almost total, the affected area of the heart muscle dies (*infarction*). (See Figure 8–8.) The clinical signs and symptoms of myocardial infarction (MI) typically include intense chest pain (*angina*), profuse sweating (*diaphoresis*), paleness (*pallor*), and labored breathing (*dyspnea*). Arrhythmia with an abnormally rapid heart rate (*tachycardia*) or an abnormally slow heart rate (*bradycardia*) may also accompany an MI.

As the heart muscle undergoes necrotic changes, it releases several highly specific cardiac enzymes, including troponin T, troponin I, and creatinine kinase (CK). The rapid elevation of these enzymes at predictable times following MI helps differentiate MI from pericarditis, abdominal aortic aneurysm (AAA), and acute pulmonary embolism.

When angina cannot be controlled with medication, surgical intervention may be necessary. In **percutaneous transluminal coronary angioplasty (PTCA)**, a deflated balloon is passed through a small incision in the skin and into the diseased blood vessel. When the balloon inflates, it presses the occluding material against the lumen walls to force open the channel. (See Figure 8–9.) After the

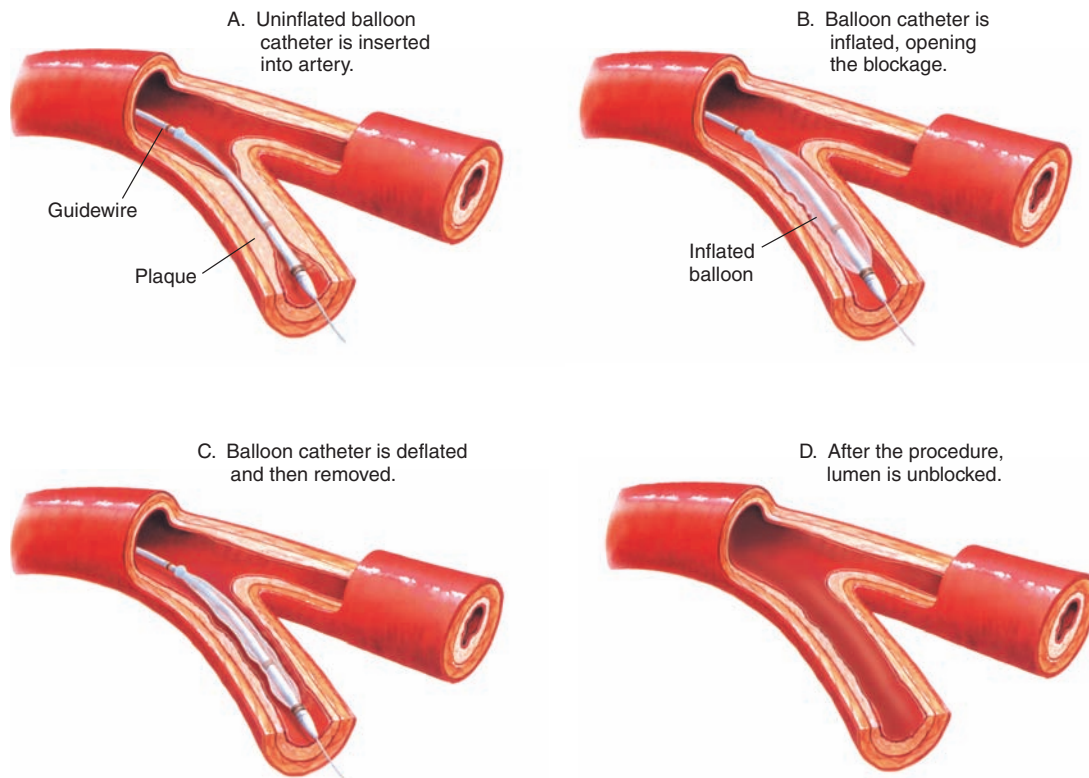


Figure 8-9. Balloon angioplasty.

procedure, the physician deflates and removes the balloon. Sometimes, the physician will place a hollow, thin mesh tube (**stent**) on the balloon and position it against the artery wall. It remains in place after the balloon catheter is removed and keeps the artery opened.

A more invasive procedure involves rerouting blood around the occluded area using a vein graft that bypasses the obstruction (**coronary artery bypass graft [CABG]**). One end of the graft vessel is sutured to the aorta and the other end is sutured to the coronary artery below the blocked area. This graft reestablishes blood flow to the heart muscle. (See Figure 8-10.)

Endocarditis

Endocarditis is an inflammation of the inner lining of the heart and its valves. It may be noninfective in nature, caused by thrombi formation, or infective, caused by various microorganisms. Although the infecting organism can be viral or fungal, the usual culprit is a bacterium. Congenital valvular defects, scarlet fever, rheumatic fever, calcified bicuspid or aortic valves, mitral valve prolapse, and prosthetic

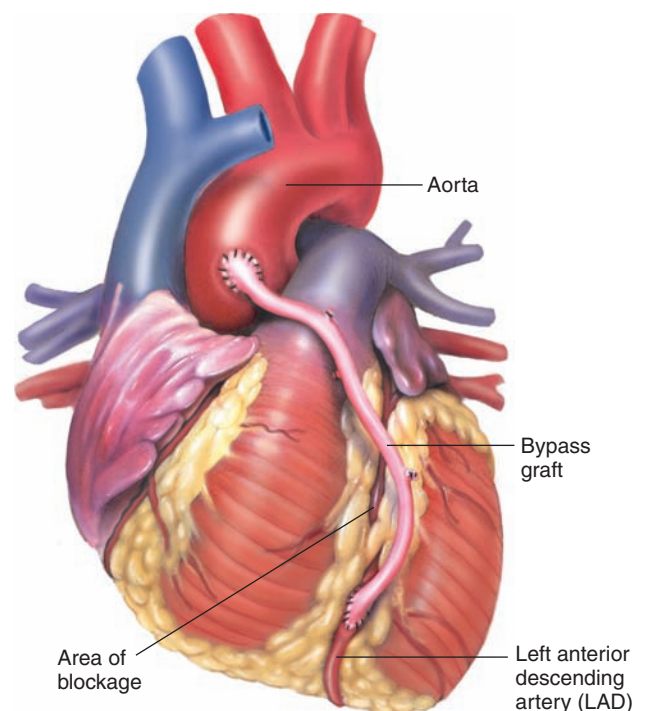


Figure 8-10. Coronary artery bypass graft.

valves are predisposing factors. Bacteria traveling in the bloodstream (**bacteremia**) may lodge in the weakened heart tissue and form small masses called *vegetations* composed of fibrin and platelets. Vegetations usually collect on the leaflets of the valves and their cords, causing a backflow of blood (**regurgitation**) or scarring. Vegetations may dislodge (**embolize**) and travel to the brain, lungs, kidneys, or spleen. Scarring of the valves may cause them to narrow (**stenosis**) or not close properly (**insufficiency**). Although medications may prove helpful, if heart failure develops as a result of damaged heart valves, surgery may be the only option. Whenever possible, the original valve is repaired. When the damage is extensive, a mechanical or bioprosthetic valve may be used.

Patients who are susceptible to endocarditis are given antibiotic treatment to protect against infection prior to invasive procedures (**prophylactic treatment**). Because many bacteria normally found in the mouth are also responsible for endocarditis, prophylactic treatment is essential for tooth removal, root canal procedures, and even routine cleaning.

Varicose Veins

Varicose veins are enlarged, twisted, superficial veins. They develop when the valves of the veins do not function properly (**incompetent**) and fail to prevent the backflow of blood. (See Figure 8–11.) Blood accumulates and the vein becomes engorged and distended. Excess fluid eventually seeps from

the vein, causing swelling in surrounding tissues (**edema**). Varicose veins may develop in almost any part of the body, including the esophagus (**varices**) and rectum (**hemorrhoids**), but occur most commonly in the greater and lesser saphenous veins of the lower legs. Types of varicose veins include reticular veins, which appear as small blue veins seen through the skin, and “spider” veins (**teleangiectases**), which look like short, fine lines, starburst clusters, or weblike mazes.

Varicose veins of the legs are not typically painful but may be unsightly in appearance. However, if open lesions or pain is present, treatment includes laser ablation, microphlebectomies, sclerotherapy, and occasionally, ligation and stripping for heavily damaged or diseased veins. The same methods are used as an elective procedure to improve the appearance of the legs. Treatment of mild cases of varicose veins includes use of elastic stockings and rest periods during which the legs are elevated.

Oncology

Although rare, the most common primary tumor of the heart is composed of mucous connective tissue (**myxoma**); however, these tumors tend to be benign. Although some myxomas originate in the endocardium of the heart chambers, most arise in the left atrium. Occasionally, they impede mitral valve function and cause a decrease in exercise tolerance, dyspnea, fluid in the lungs (**pulmonary edema**), and systemic problems, including joint

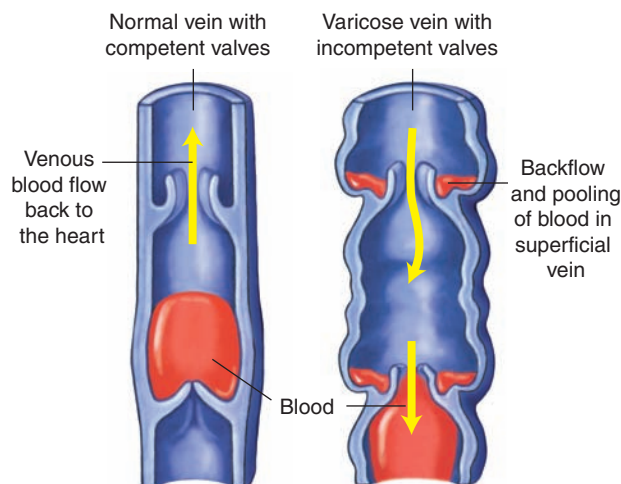


Figure 8-11. Healthy and unhealthy veins and valves. (A) Valve function in competent and incompetent valves. (B) Varicose veins.

pain (**arthralgia**), malaise, and anemia. These tumors are usually identified and located by two-dimensional echocardiography. When present, they should be excised surgically.

Most malignant tumors of the heart are the result of a malignancy originating in another area of the body (**primary tumor**) that has spread

(**metastasized**) to the heart. The most common type originates in a darkly pigmented mole or tumor (**malignant melanoma**) of the skin. Other primary sites of malignancy that metastasize to the heart are bone marrow and lymphatic tissue. Treatment of the metastatic tumor of the heart involves treating the primary tumor.

Diagnostic, Symptomatic, and Related Terms

This section introduces diagnostic, symptomatic, and related terms and their meanings. Word analyses for selected terms are also provided

Term	Definition
aneurysm ĀN-ū-rīzm	Localized abnormal dilation of a vessel, usually an artery
arrest	Condition of being stopped or bringing to a stop
cardiac KĀR-dē-āk <i>cardi</i> : heart -ac: pertaining to, relating to	Loss of effective cardiac function, which results in cessation of circulation <i>Cardiac arrest (CA) may be due to ventricular fibrillation or asystole in which there is no observable myocardial activity.</i>
circulatory SĔR-kū-lā-tor-ē	Cessation of the circulation of blood due to ventricular standstill or fibrillation
arrhythmia ă-RĪTH-mē-ă	Inability of the heart to maintain a normal sinus rhythm, possibly including a rapid or slow beat or “skipping” a beat; also called <i>dysrhythmia</i>
bruit brwē	Soft blowing sound heard on auscultation, possibly due to vibrations associated with the movement of blood, valvular action, or both; also called <i>murmur</i>
cardiomyopathy kār-dē-ō-mī-ŌP-ă-thē <i>cardi/o</i> : heart <i>my/o</i> : muscle - <i>pathy</i> : disease	Any disease or weakening of heart muscle that diminishes cardiac function <i>Causes of cardiomyopathy include viral or bacterial infections, metabolic disorders, or general systemic disease.</i>
catheter KĀTH-ě-tēr	Thin, flexible, hollow plastic tube that is small enough to be threaded through a vein, artery, or tubular structure
coarctation kō-ărk-TĀ-shŭn	Narrowing of a vessel, especially the aorta
deep vein thrombosis (DVT) thrŏm-BŌ-sīs <i>thromb</i> : blood clot - <i>osis</i> : abnormal condition; increased (used primarily with blood cells)	Blood clot that forms in the deep veins of the body, especially those in the legs or thighs <i>In DVT, blood clots may break away from the vein wall and travel in the body. If they lodge in the lung, the condition is called pulmonary embolism. Pulmonary embolism may be life threatening if a large portion of the lung is damaged.</i>
ejection fraction (EF)	Calculation of how much blood a ventricle can eject with one contraction <i>The left ventricular EF averages 50% to 70% in healthy hearts but can be markedly reduced if part of the heart muscle dies, as evident after an MI or in cardiomyopathy or valvular heart disease.</i>

(continued)

Diagnostic, Symptomatic, and Related Terms—cont'd	
Term	Definition
heart failure (HF)	Failure of the heart to supply an adequate amount of blood to tissues and organs <i>HF is commonly caused by impaired coronary blood flow, cardiomyopathies, and heart valve disease.</i>
embolus ĔM-bō-lūs <i>embol</i> : embolus (plug) <i>-us</i> : condition, structure	Mass of undissolved matter (foreign object, air, gas, tissue, thrombus) circulating in blood or lymphatic channels until it becomes lodged in a vessel
fibrillation fī-brīl-Ā-shŭn	Quivering or spontaneous muscle contractions, especially of the heart, causing ineffectual contractions <i>Fibrillation is commonly corrected with a defibrillator.</i>
hemostasis hē-mō-STĀ-sīs <i>hem/o</i> : blood <i>-stasis</i> : standing still	Arrest of bleeding or circulation
hyperlipidemia hī-pēr-līp-ī-DĒ-mē-ă <i>hyper-</i> : excessive, above normal <i>lipid</i> : fat <i>-emia</i> : blood condition	Excessive amounts of lipids (cholesterol, phospholipids, and triglycerides) in the blood <i>The term hypercholesterolemia refers to elevation of cholesterol in the blood. It has been associated with an increased risk of atherosclerosis.</i>
hypertension (HTN) hī-pēr-TĒN-shŭn <i>hyper-</i> : excessive, above normal <i>-tension</i> : to stretch primary	Common disorder characterized by elevated blood pressure persistently exceeding 140 mm Hg systolic or 90 mm Hg diastolic HTN in which there is no identifiable cause; also called <i>essential hypertension</i> <i>Primary hypertension is the most common form of hypertension and is associated with obesity, a high serum sodium level, hypercholesterolemia, or family history.</i>
secondary	HTN that results from an underlying, identifiable, commonly correctable cause
hypertensive heart disease hī-pēr-TĒN-sīv	Any heart disorder caused by prolonged hypertension, including left ventricular hypertrophy, coronary artery disease, cardiac arrhythmias, and heart failure
implantable cardioverter-defibrillator (ICD) KĀR-dē-ō-vēr-tēr-dē-FĪB-rī-lā-tor	Implantable battery-powered device that monitors and automatically corrects ventricular tachycardia or fibrillation by sending electrical impulses to the heart (See Figure 8-12.) <i>In ventricular fibrillation, the heart quivers rather than beats, and blood is not pumped to the brain. Unless treatment is received within 5 to 10 minutes, ventricular fibrillation causes death.</i>
infarct ĪN-fārkt	Area of tissue that undergoes necrosis following cessation of blood supply

Diagnostic, Symptomatic, and Related Terms—cont'd

Term

Definition

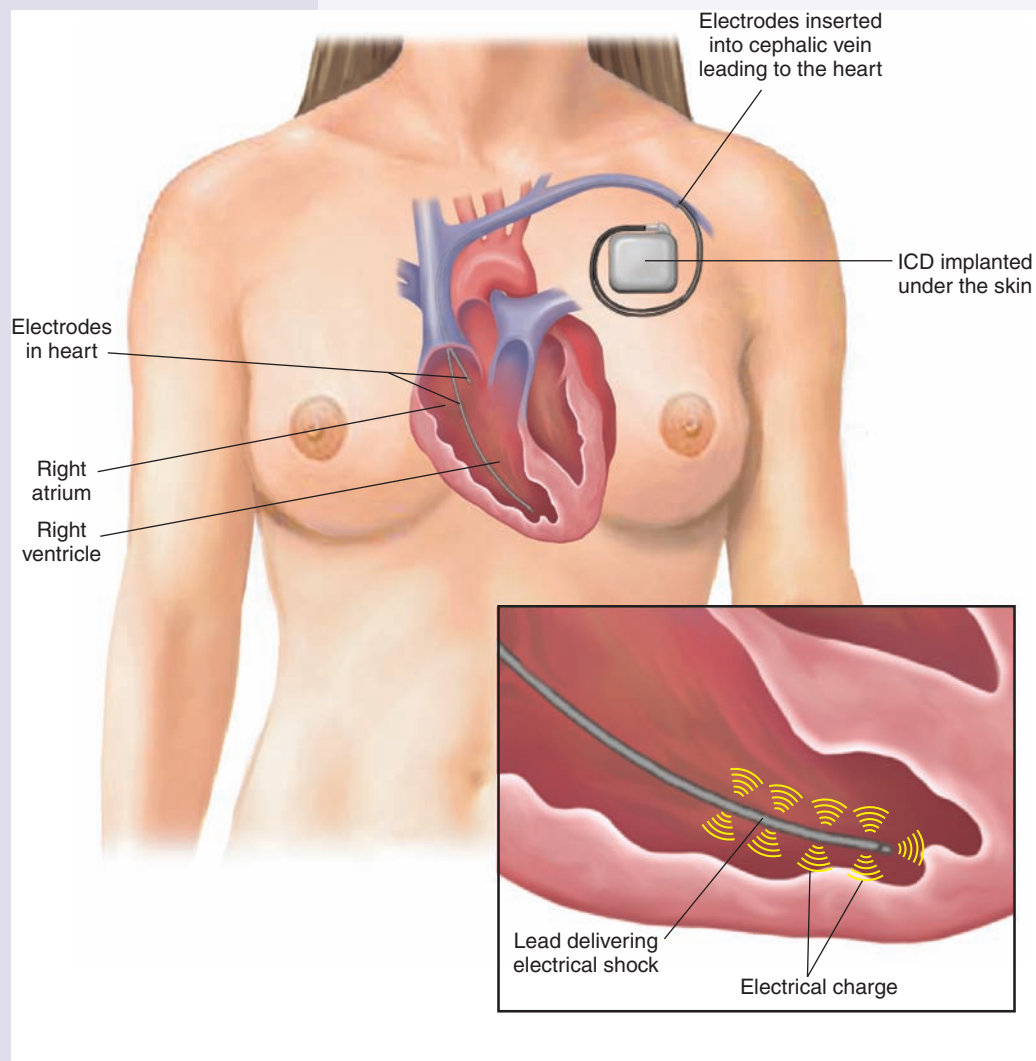


Figure 8-12. Implantable cardioverter-defibrillator (ICD).

ischemia

is-KĒ-mē-ă

Local and temporary deficiency of blood supply due to circulatory obstruction

mitral valve prolapse (MVP)

MĪ-trăl, PRŌ-lăps

Common and occasionally serious condition in which the leaflets of the mitral valve prolapse into the left atrium during systole causing a characteristic murmur heard on auscultation

Common signs and symptoms of MVP include palpitations of the heart and, occasionally, panic attacks with pounding heartbeat. Because of the possibility of valve infection, prophylactic treatment with antibiotics is suggested before undergoing invasive procedures such as dental work.

radioisotope

rā-dē-ō-Ī-sō-tōp

Chemical radioactive material used as a tracer to follow a substance through the body or a structure

(continued)

Diagnostic, Symptomatic, and Related Terms—cont'd

Term	Definition
palpitation pāl-pī-TĀ-shŭn	Sensation that the heart is not beating normally, possibly including “thumping,” “fluttering,” “skipped beats,” or a pounding feeling in the chest <i>Although most palpitations are harmless, those caused by arrhythmias may be serious. Medical attention should be sought if palpitations are accompanied by pain, dizziness, overall weakness, or shortness of breath.</i>
patent ductus arteriosus PĀT-ĕnt DŪK-tŭs ār-tē-rē-Ō-sŭs	Failure of the ductus arteriosus to close after birth, allowing blood to flow from the aorta into the pulmonary (lung) artery
perfusion pĕr-FŪ-zhŭn	Circulation of blood through tissues or the passage of fluids through vessels of an organ
tetralogy of Fallot tĕ-TRĀL-ō-jĕ, fāl-Ō	Congenital anomaly consisting of four elements: (1) pulmonary artery stenosis; (2) interventricular septal defect; (3) transposition of the aorta, so that both ventricles empty into the aorta; (4) right ventricular hypertrophy caused by increased workload of the right ventricle
stent stĕnt	Slender or threadlike device used to hold open vessels, tubes, or obstructed arteries <i>Stents are used to support tubular structures that are being anastomosed or to induce or maintain patency within these tubular structures.</i>
thrombus THRŌM-bŭs <i>thromb</i> : blood clot <i>-us</i> : condition; structure	Blood clot that obstructs a vessel



It is time to review pathological, diagnostic, symptomatic, and related terms by completing Learning Activity 8–3.

Diagnostic and Therapeutic Procedures

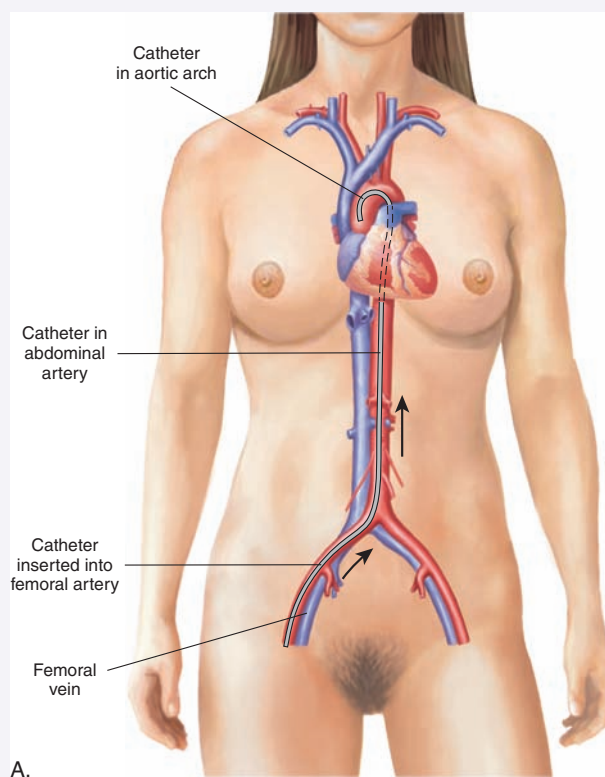
This section introduces procedures used to diagnose and treat cardiovascular disorders. Descriptions are provided as well as pronunciations and word analyses for selected terms

Procedure	Description
Diagnostic Procedures	
Clinical	
cardiac catheterization (CC) KĀR-dē-āk kăth-ĕ-tĕr-ĭ-ZĀ-shŭn <i>cardi</i> : heart <i>-ac</i> : pertaining to, relating to	Passage of a catheter into the heart through a vein or artery to provide a comprehensive evaluation of the heart (See Figure 8-13.) <i>CC gathers information about the heart, such as blood supply through the coronary arteries and blood flow and pressure in the chambers of the heart as well as enabling blood sample collection and x-rays of the heart.</i>
electrocardiogram (ECG, EKG) ē-lĕk-trō-KĀR-dē-ō-grăm <i>electr/o</i> : electricity <i>cardi/o</i> : heart <i>-gram</i> : record, writing	Graphic line recording that shows the spread of electrical excitation to different parts of the heart using small metal electrodes applied to the chest, arms, and legs <i>ECGs help diagnose abnormal heart rhythms and myocardial damage.</i>

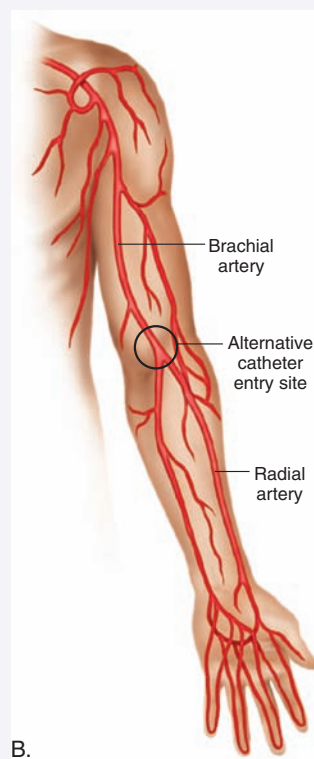
Diagnostic and Therapeutic Procedures—cont'd

Procedure

Description



A.

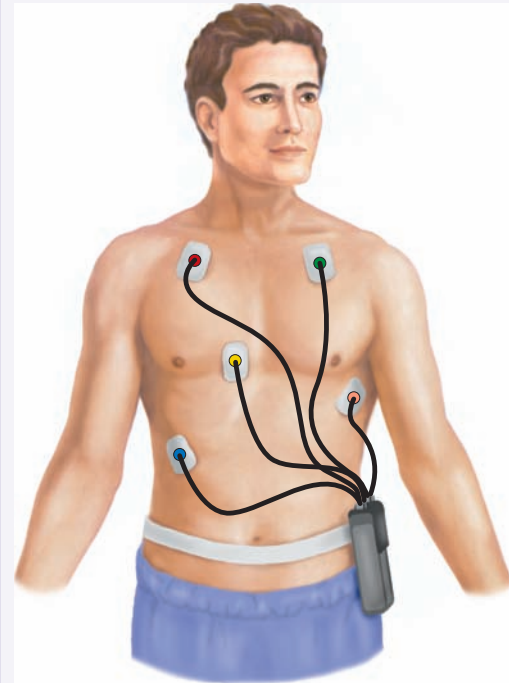


B.

Figure 8-13. Cardiac catheterization. (A) Catheter insertion in femoral vein or artery. (B) Catheter insertion in brachial or radial artery.

(continued)

Diagnostic and Therapeutic Procedures—cont'd

Procedure	Description
Holter monitor test HŌL-tēr MŌN-ī-tor	<p>ECG taken with a small portable recording system capable of storing up to 24 hours of ECG tracings (See Figure 8-14.)</p> <p><i>Holter monitoring is particularly useful in obtaining a cardiac arrhythmia record that would be missed during an ECG of only a few minutes' duration.</i></p>
	
<p>Figure 8-14. Holter monitor.</p>	
stress test	<p>ECG taken under controlled exercise stress conditions</p> <p><i>A stress test may show abnormal ECG tracings that do not appear during an ECG taken when the patient is resting.</i></p>
nuclear	<p>ECG that utilizes a radioisotope to evaluate coronary blood flow</p> <p><i>In a nuclear stress test, the radioisotope is injected at the height of exercise. The area not receiving sufficient oxygen is visualized by decreased uptake of the isotope.</i></p>
<p>Laboratory</p>	
cardiac enzyme studies KĀR-dē-āk ĔN-zīm	<p>Blood test that measures troponin T, troponin I, and creatinine kinase (CK-MB)</p> <p><i>Cardiac enzymes are released into the bloodstream from damaged heart muscle tissue. Their presence in a blood specimen is consistent with myocardial damage.</i></p>
lipid panel LĪP-īd	<p>Series of tests (total cholesterol, high density lipoprotein, low density lipoprotein, and triglycerides) used to assess risk factors of ischemic heart disease</p>

Diagnostic and Therapeutic Procedures—cont'd

Procedure	Description
Radiographic	
angiography ăn-jē-ŌG-ră-fē <i>angi/o</i> : vessel (usually blood or lymph) <i>-graphy</i> : process of recording coronary KOR-ō-nă-rē ăn-jē-ŌG-ră-fē	Radiographic imaging of the heart and blood vessels after injection of a contrast dye Angiography to determine the degree of obstruction of the arteries that supply blood to the heart <i>In coronary angiography, a catheter is inserted into the femoral artery and threaded to the aorta. The contrast dye outlines the coronary arteries and shows narrowing, stenosis, or blockage.</i>
digital subtraction ăn-jē-ŌG-ră-fē	Angiography in which two radiographic images are obtained, the first one without contrast material and the second one after a contrast material has been injected, and then compared by a computer that digitally subtracts (removes) the images of soft tissues, bones, and muscles, leaving only the image of vessels with contrast
aortography ā-or-TŌG-ră-fē <i>aort/o</i> : aorta <i>-graphy</i> : process of recording	Radiological examination of the aorta and its branches following injection of a contrast medium via a catheter
echocardiography (ECHO) ěk-ō-kăr-dē-ŌG-ră-fē <i>echo-</i> : repeated sound <i>cardi/o</i> : heart <i>-graphy</i> : process of recording Doppler ultrasound DŌP-lēr	Noninvasive diagnostic method that uses ultrasound to visualize internal cardiac structures and produce images of the heart <i>A transducer is placed on the chest to direct ultra-high-frequency sound waves toward cardiac structures. Reflected echoes are then converted to electrical impulses and displayed on a screen.</i> Noninvasive adaptation of ultrasound technology in which blood flow velocity is assessed in different areas of the heart <i>Sound waves strike moving red blood cells and are reflected back to a recording device that graphically records blood flow through cardiac structures.</i>
magnetic resonance imaging (MRI) măg-NĚT-ik RĚZ-ěn-ăns ĪM-ĭj-ĭng	Noninvasive technique that uses radiowaves and a strong magnetic field, rather than an x-ray beam, to produce multiplanar cross-sectional images of blood vessels <i>MRI provide information about aneurysms, cardiac structures, and cardiac output. Magnetic resonance angiography (MRA) is a type of MRI that provides highly detailed images of the blood vessels. MRA is used to view arteries and blockages within the arteries. A radiopaque contrast dye can be injected to provide greater detail of body structures.</i>
multiple-gated acquisition (MUGA)	Nuclear procedure that uses radioactive tracers to produce movie-like images of the structures of the heart, including the myocardium and the mitral and tricuspid valves <i>The MUGA scan shows the motion of the heart wall muscle and the ventricle's ability to eject blood (ejection fraction).</i>

(continued)

Diagnostic and Therapeutic Procedures—cont'd	
Procedure	Description
phonocardiography fō-nō-kār-dē-ŌG-rā-fē <i>phon/o:</i> voice, sound <i>cardi/o:</i> heart <i>-graphy:</i> process of recording	Imaging technique that provides a graphic display of heart sounds and murmurs during the cardiac cycle <i>In phonocardiography, a transducer sends ultrasonic pulses through the chest wall and the echoes are converted into images on a monitor to assess overall cardiac performance.</i>
scintigraphy sīn-TĪG-rā-fē thallium study (resting) THĀL-ē-ŭm	Diagnostic test that uses radiation emitted by the body after an injection of radioactive substances to create images of various organs or identify body functions and diseases <i>Scintigraphy identifies infarcted or scarred areas of the heart that show up as “cold spots” (areas of reduced radioactivity), taken when the patient is at rest.</i> Scintigraphy procedure that uses injected radioactive thallium and records the uptake of the isotope with a gamma camera to produce an image <i>A stress thallium study is commonly performed at the same time as a resting study, and the two images are compared to further identify abnormalities.</i>
sclerotherapy sklēr-ō-TĪER-ă-pē <i>scler/o:</i> hardening; sclera (white of the eye) <i>-therapy:</i> treatment	Injection of a chemical irritant (sclerosing agent) into a vein to produce inflammation and fibrosis that destroys the lumen of the vein <i>Sclerotherapy is commonly performed to treat varicose veins and sometimes telangiectasias.</i>
venography vē-NŌG-rā-fē <i>ven/o:</i> vein <i>-graphy:</i> process of recording	Radiography of a vein after injection of a contrast medium to detect incomplete filling of a vein, which indicates obstruction <i>Venography is used primarily to locate blood clots in veins of the leg.</i>
Therapeutic Procedures	
Clinical	
cardioversion KĀR-dē-ō-vēr-zhŭn <i>cardi/o:</i> heart <i>-version:</i> turning	Procedure to restore normal rhythm of the heart by applying a controlled electrical shock to the exterior of the chest
embolization ěm-bō-lī-ZĀ-shŭn <i>embol:</i> plug <i>-ization:</i> process (of)	Technique used to block blood flow to a site by passing a catheter to the area and injecting a synthetic material or medication specially designed to occlude the blood vessel <i>Embolization may serve to eliminate an abnormal communication between an artery and a vein, stop bleeding, or close vessels that are supporting tumor growth.</i>
Surgical	
angioplasty AN-jē-ō-plās-tē <i>angi/o:</i> vessel (usually blood or lymph) <i>-plasty:</i> surgical repair	Procedure that alters a vessel through surgery or dilation of the vessel using a balloon catheter
coronary artery bypass graft (CABG) KOR-ō-nā-rē ĀR-tēr-ē	Surgical procedure that uses a vessel graft from another part of the body to bypass the blocked part of a coronary artery and restore blood supply to the heart muscle

Diagnostic and Therapeutic Procedures—cont'd

Procedure	Description
<p>percutaneous transluminal coronary angioplasty (PTCA) pěr-kū-TĀ-nē-ŭs trāns-LŪ-mī-nāl KOR-ō-nā-rē ĀN-jē-ō-plās-tē <i>per-</i>: through <i>cutane</i>: skin <i>-ous</i>: pertaining to, relating to</p>	<p>Dilation of an occluded vessel using a balloon catheter under fluoroscopic guidance</p> <p><i>In PTCA, the physician inserts a catheter transcutaneously, inflates the balloon thereby dilating the narrowed vessel, and commonly positions a stent to hold the vessel open.</i></p>
<p>atherectomy ăth-ēr-ĔK-tō-mē <i>ather</i>: fatty plaque <i>-ectomy</i>: excision, removal</p>	<p>Removal of material from an occluded vessel using a specially designed catheter fitted with a cutting or grinding device</p>
<p>biopsy BĪ-ōp-sē</p> <p>arterial ăr-TĔ-rē-ăl <i>arteri</i>: artery <i>-al</i>: pertaining to, relating to</p>	<p>Removal and examination of a small piece of tissue for diagnostic purposes</p> <p>Removal and examination of a segment of an arterial vessel wall to confirm inflammation of the wall or arteritis, a type of vasculitis</p>
<p>catheter ablation KĀTH-ĕ-tēr äb-LĀ-shŭn</p>	<p>Destruction of conduction tissue of the heart to interrupt the abnormal conduction pathway causing the arrhythmia, thus allowing normal heart rhythm to resume</p> <p><i>Catheter ablation is usually performed under fluoroscopic guidance.</i></p>
<p>commissurotomy kôm-i-shŭr-ŌT-ō-mē</p>	<p>Surgical separation of the leaflets of the mitral valve, which have fused together at their “commissures” (points of touching)</p> <p><i>Many candidates for commissurotomy are now treated with balloon mitral valvuloplasty.</i></p>
<p>laser ablation LĀ-zēr äb-LĀ-shŭn</p>	<p>Procedure used to remove or treat varicose veins</p> <p><i>In laser ablation, the laser’s heat coagulates blood inside the vessel, causing it to collapse and seal. Later, the vessels dissolve within the body, becoming less visible, or disappear altogether.</i></p>
<p>ligation and stripping lī-GĀ-shŭn, STRĪP-ing</p>	<p>Tying a varicose vein (ligation) followed by removal (stripping) of the affected segment</p> <p><i>Ligation and stripping are procedures performed for heavily damaged or diseased veins. Usual treatment for varicose veins is laser ablation in combination with microphlebectomies and sclerotherapy.</i></p>
<p>open heart surgery</p>	<p>Surgical procedure performed on or within the exposed heart, usually with the assistance of a heart-lung machine</p> <p><i>During the operation, the heart-lung machine takes over circulation to allow surgery on the resting (nonbeating) heart. After the heart has been restarted and is beating, the patient is disconnected from the heart-lung machine. Types of open heart surgery include coronary artery bypass graft, valve replacement, and heart transplant.</i></p>

(continued)

Diagnostic and Therapeutic Procedures—cont'd	
Procedure	Description
pericardiocentesis pĕr-ĭ-kărdĕ-ō-sĕn-TĒ-sĭs <i>peri-</i> : around <i>cardi/o</i> : heart <i>-centesis</i> : surgical puncture	Puncturing of the pericardium to remove excess fluid from the pericardial sac or to test for protein, sugar, and enzymes or determine the causative organism of pericarditis
thrombolysis thrŏm-BŎL-ĭ-sĭs <i>thromb/o</i> : blood clot <i>-lysis</i> : separation; destruction; loosening intravascular ĭn-tră-VĀS-kū-lăr <i>intra-</i> : in, within <i>vascul/o</i> : vessel <i>-ar</i> : pertaining to, relating to	Destruction of a blood clot using anticlotting agents called <i>clot-busters</i> , such as tissue plasminogen activator <i>Prompt thrombolysis can restore blood flow to tissue before serious irreversible damage occurs. However, many thrombolytic agents also pose the risk of hemorrhage.</i> Infusion of a thrombolytic agent into a vessel to dissolve a blood clot
valvotomy văl-VŎT-ŏ-mĕ <i>valv/o</i> : valve <i>-tomy</i> : incision	Incision of a valve to increase the size of the opening; used in treating mitral stenosis
venipuncture VĒN-ĭ-pŭnk-chŭr	Puncture of a vein by a needle attached to a syringe or catheter to withdraw a specimen of blood; also called <i>phlebotomy</i>

Pharmacology

A healthy, functional cardiovascular system is needed to ensure adequate blood circulation and efficient delivery of oxygen and nutrients to all parts of the body. When any part of the cardiovascular system malfunctions or becomes diseased, drug therapy plays an integral role in

establishing and maintaining perfusion and homeostasis.

Medications are used to treat a variety of cardiovascular conditions, including angina pectoris, myocardial infarction, heart failure (HF), arrhythmias, hypertension, hyperlipidemia, and vascular disorders. (See Table 8–1.) Many of the cardiovascular drugs treat multiple problems simultaneously.

Table 8-1 **Drugs Used to Treat Cardiovascular Disorders**

This table lists common drug classifications used to treat cardiovascular disorders, their therapeutic actions, and selected generic and trade names.

Classification	Therapeutic Action	Generic and Trade Names
angiotensin-converting enzyme inhibitors	Lower blood pressure by inhibiting the conversion of angiotensin I (an inactive enzyme) to angiotensin II (a potent vasoconstrictor). <i>Angiotensin-converting enzyme (ACE) inhibitors are used to treat hypertension alone or with other agents and aid in the management of heart failure.</i>	benazepril bĕn-Ā-ză-prĭl Lotensin captopril KĀP-tŏ-prĭl Capoten

Table 8-1 Drugs Used To Treat Cardiovascular Disorders—cont'd

Classification	Therapeutic Action	Generic and Trade Names
antiarrhythmics	Prevent, alleviate, or correct cardiac arrhythmias (dysrhythmias) by stabilizing the electrical conduction of the heart. <i>Antiarrhythmics are used to treat atrial and ventricular dysrhythmias.</i>	flecainide flĕ-KĀ-nĭd Tambocor
beta-blockers	Block the effect of adrenaline on beta receptors, which slow nerve pulses that pass through the heart, thereby causing a decrease heart rate and contractility. <i>Beta-blockers are prescribed for hypertension, angina, and arrhythmias (dysrhythmias).</i>	atenolol ă-TĒN-ō-lōl Tenormin metoprolol mĕ-TŌ-prō-lōl Lopressor, Toprol-XL
calcium channel blockers	Block movement of calcium (required for blood vessel contraction) into myocardial cells and arterial walls, causing heart rate and blood pressure to decrease <i>Calcium channel blockers are used to treat angina pectoris, hypertension, arrhythmias, and heart failure.</i>	amlodipine ăm-LŌ-dĭ-pĕn Norvasc diltiazem dĭl-TĪ-ă-zĕm Cardizem CD nifedipine nĭ-FĒD-ĭ-pĕn Adalat CC, Procardia
diuretics	Act on kidneys to increase excretion of water and sodium. <i>Diuretics reduce fluid build-up in the body, including fluid in the lungs, a common symptom of heart failure. Diuretics are also used to treat hypertension.</i>	furosemide fū-RŌ-sĕ-mĭd Lasix
nitrates	Dilate blood vessels of the heart, causing an increase in the amount of oxygen delivered to the myocardium, and decrease venous return and arterial resistance, which decreases myocardial oxygen demand and relieves angina. <i>Nitrates can be administered in several ways: sublingually as a spray or tablet, orally as a tablet, transdermally as a patch, topically as an ointment, or intravenously in an emergency setting.</i>	nitroglycerin nĭ-trō-GLĪS-ĕr-ĭn Nitrolingual, Nitrogard, Nitrostat
statins	Lower cholesterol in the blood and reduce its production in the liver by blocking the enzyme that produces it. <i>Vitorin, a statin drug, combined with a cholesterol absorption inhibitor not only lowers cholesterol in the blood and reduces its production in the liver, but also decreases absorption of dietary cholesterol from the intestine. Hypercholesterolemia is a major factor in development of heart disease. Dilate arteries in skeletal muscles, thus improving peripheral blood flow.</i>	atorvastatin ăh-tōr-vă-STĀ-tĭn Lipitor simvastatin SĪM-vă-stă-tĭn Zocor simvastatin and ezetimibe SĪM-vă-stă-tĭn, ě-ZĒ-tĭ-mĭb Vytorin

(continued)

Table 8-1 **Drugs Used to Treat Cardiovascular Disorders—cont'd**

Classification	Therapeutic Action	Generic and Trade Names
peripheral vasodilators	<i>Peripheral vasodilators treat peripheral vascular diseases, diabetic peripheral vascular insufficiency, and Raynaud disease.</i>	cylandelate sĭ-KLĀN-dĕ-lāt Cyclan isoxsuprine Ī-SŎK-sŭ-prĕn Vasodilan

Abbreviations

This section introduces cardiovascular-related abbreviations and their meanings.

Abbreviation	Meaning	Abbreviation	Meaning
AAA	abdominal aortic aneurysm	CHD	coronary heart disease
ACE	angiotensin-converting enzyme (inhibitor)	Chol	cholesterol
AF	atrial fibrillation	CK	creatine kinase (cardiac enzyme); conductive keratoplasty
AS	aortic stenosis	CPR	cardiopulmonary resuscitation
ASD	atrial septal defect	CV	cardiovascular
ASHD	arteriosclerotic heart disease	DES	drug-eluting stent
AST	angiotensin sensitivity test	DOE	dyspnea on exertion
AV	atrioventricular; arteriovenous	DSA	digital subtraction angiography
BBB	bundle-branch block	DVT	deep vein thrombosis, deep venous thrombosis
BP, B/P	blood pressure	ECG, EKG	electrocardiogram; electrocardiography
CA	cancer; chronological age; cardiac arrest	ECHO	echocardiogram echocardiography; echo- encephalogram, echoencephalography
CABG	coronary artery bypass graft	EF	ejection fraction
CAD	coronary artery disease	ETT	exercise tolerance test
CC	cardiac catheterization	HDL	high-density lipoprotein
CCU	coronary care unit	HF	heart failure

Abbreviations—cont'd			
Abbreviation	Meaning	Abbreviation	Meaning
HTN	hypertension	MUGA	Multiple-gated acquisition (scan)
ICD	implantable cardioverter defibrillator	MVP	mitral valve prolapse
IV	intravenous	NSR	normal sinus rhythm
LA	left atrium	PAC	premature atrial contraction
LD	lactate dehydrogenase; lactic acid dehydrogenase (cardiac enzyme)	PTCA	percutaneous transluminal coronary angioplasty
LDL	low-density lipoprotein	PVC	premature ventricular contraction
LV	left ventricle	RA	right atrium
MI	myocardial infarction	RV	residual volume; right ventricle
MR	mitral regurgitation	SA, S-A	sinoatrial
MRA	magnetic resonance angiogram; magnetic resonance angiography	SOB	shortness of breath
MRI	magnetic resonance imaging	VSD	ventricular septal defect
MS	musculoskeletal; multiple sclerosis; mitral stenosis; mental status	VT	ventricular tachycardia



It is time to review procedures, pharmacology, and abbreviations by completing Learning Activity 8–4.

LEARNING ACTIVITIES

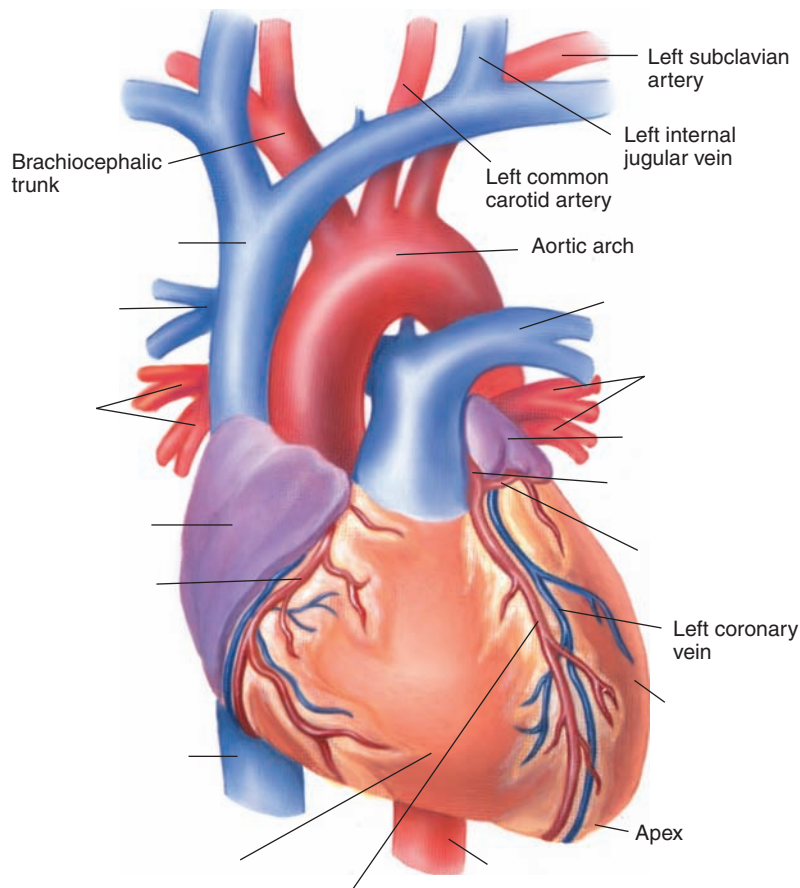
The following activities provide review of the cardiovascular system terms introduced in this chapter. Complete each activity and review your answers to evaluate your understanding of the chapter.

Learning Activity 8-1

Identifying Cardiovascular Structures

Label the following illustration using the terms listed below.

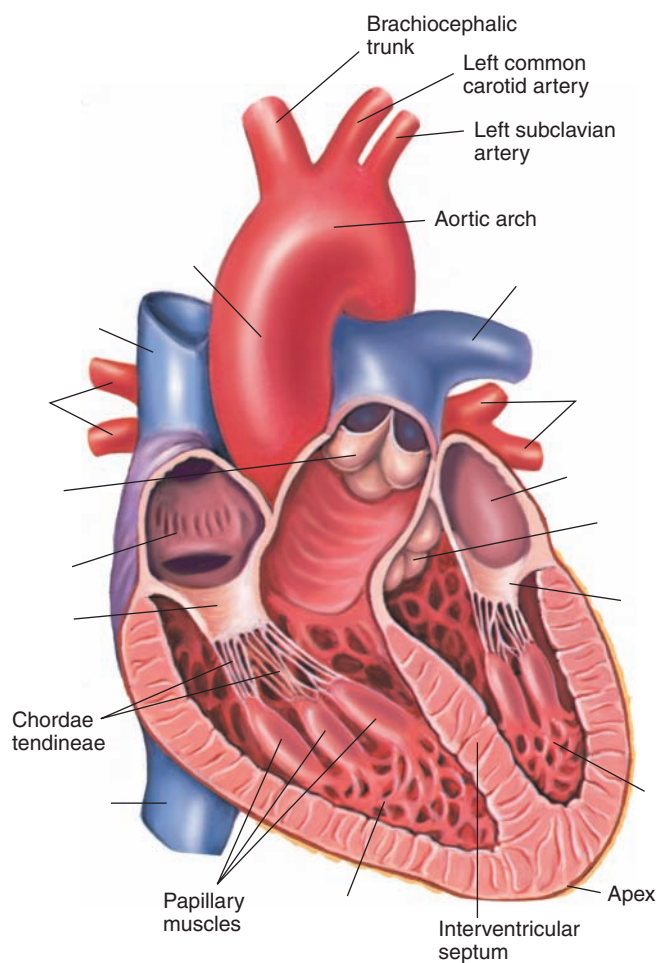
<i>aorta</i>	<i>left coronary artery</i>	<i>right coronary artery</i>
<i>circumflex artery</i>	<i>left pulmonary artery</i>	<i>right pulmonary artery</i>
<i>inferior vena cava</i>	<i>left pulmonary veins</i>	<i>right pulmonary veins</i>
<i>left anterior descending artery</i>	<i>left ventricle</i>	<i>right ventricle</i>
<i>left atrium</i>	<i>right atrium</i>	<i>superior vena cava</i>




Check your answers by referring to Figure 8–2A on page 189. Review material that you did not answer correctly.

Label the following illustration using the terms listed below.

aorta left pulmonary veins right pulmonary veins
 aortic semilunar valve left ventricle right ventricle
 inferior vena cava mitral (bicuspid) valve superior vena cava
 left atrium pulmonic valve tricuspid valve
 left pulmonary artery right atrium



 Check your answers by referring to Figure 8–2B on page 189. Review material that you did not answer correctly.

 DavisPlus.fadavis.com

Enhance your study and reinforcement of word elements with the power of DavisPlus. Visit www.davisplus.fadavis.com/gyls/systems for this chapter's flash-card activity. We recommend you complete the flash-card activity before completing Activity 8–2 below.

Learning Activity 8-2

Building Medical Words

Use *ather/o* (fatty plaque) to build words that mean:

1. tumor of fatty plaque _____
2. hardening of fatty plaque _____

Use *phleb/o* (vein) to build words that mean:

3. inflammation of a vein (wall) _____
4. abnormal condition of a blood clot in a vein _____

Use *ven/o* (vein) to build words that mean:

5. pertaining to a vein _____
6. spasm of a vein _____

Use *cardi/o* (heart) to build words that mean:

7. specialist in the study of the heart _____
8. rupture of the heart _____
9. poisonous to the heart _____
10. enlargement of the heart _____

Use *angi/o* (vessel) to build words that mean:

11. softening of a vessel (wall) _____
12. tumor of a vessel _____

Use *thromb/o* (blood clot) to build words that mean:

13. beginning or formation of a blood clot _____
14. abnormal condition of a blood clot _____

Use *aort/o* (heart) to build words that mean:

15. abnormal condition of narrowing or stricture of the aorta _____
16. process of recording the aorta _____

Build surgical words that mean:

17. puncture of the heart _____
18. suture of an artery _____
19. removal of an embolus _____
20. separation, destruction, or loosening of a blood clot _____



Check your answers in Appendix A. Review material that you did not answer correctly.

Correct Answers _____ × 5 = _____ % Score

Learning Activity 8-3

Matching Pathological, Diagnostic, Symptomatic, and Related Terms

Match the following terms with the definitions in the numbered list.

<i>aneurysm</i>	<i>bruit</i>	<i>diaphoresis</i>	<i>incompetent</i>	<i>perfusion</i>
<i>angina</i>	<i>catheter</i>	<i>embolus</i>	<i>infarct</i>	<i>stent</i>
<i>arrest</i>	<i>coarctation</i>	<i>hyperlipidemia</i>	<i>ischemia</i>	<i>varices</i>
<i>arrhythmia</i>	<i>deep vein thrombosis</i>	<i>hypertension</i>	<i>palpitation</i>	<i>vegetations</i>

1. area of tissue that undergoes necrosis _____
2. chest pain _____
3. inability of a valve to close completely _____
4. small masses of inflammatory material found on the leaflets of valves _____
5. varicose veins of the esophagus _____
6. soft, blowing sound heard on auscultation; murmur _____
7. thin, flexible, hollow tube that can be inserted into a vessel or cavity (vein or artery) of the body _____
8. sensation of the heart not beating normally _____
9. blood clot that often forms in the legs and thighs and may lead to pulmonary thrombosis _____
10. localized abnormal dilation of a vessel _____
11. mass of undissolved matter circulating in blood or lymph channels _____
12. inability of the heart to maintain a steady beat _____
13. condition of being stopped or bringing to a stop _____
14. profuse sweating _____
15. slender or threadlike device used to support tubular structures or hold arteries open during and after angioplasty _____
16. common disorder characterized by persistent elevated blood pressure _____
17. excessive amounts of lipids in the blood _____
18. narrowing of a vessel, especially the aorta _____
19. local and temporary deficiency of blood supply due to circulatory obstruction _____
20. circulation of blood through tissues _____



Check your answers in Appendix A. Review any material that you did not answer correctly.

Correct Answers _____ × 5 = _____ % Score

Learning Activity 8-4

Matching Procedures, Pharmacology, and Abbreviations

Match the following terms with the definitions in the numbered list.

angioplasty	catheter ablation	embolization	scintigraphy
arterial biopsy	commissurotomy	Holter monitor test	statins
atherectomy	coronary angiography	ligation and stripping	stress test
CABG	diuretics	nitrates	thrombolysis
cardiac enzyme studies	echocardiography	PTCA	venipuncture

1. 24-hour ECG tracing taken with a small, portable recording system _____
2. noninvasive ultrasound diagnostic test used to visualize internal cardiac structures _____
3. radiological examination of the blood vessels of and around the heart _____
4. agents used to treat angina _____
5. drugs that have powerful lipid-lowering properties _____
6. management of edema associated with heart failure and hypertension _____
7. include troponin T, troponin I, and creatinine kinase _____
8. injection and detection of radioactive isotopes to create images and identify function and disease

9. ECG taken under controlled exercise stress conditions _____
10. tying of a varicose vein and subsequent removal _____
11. surgical separation of the leaflets of the mitral valve _____
12. removal of a small segment of an artery for diagnostic purposes _____
13. destruction of conductive tissue of the heart to interrupt abnormal contractions _____
14. technique used to block flow to a site by injecting an occluding agent _____
15. procedure that alters a vessel through surgery or dilation _____
16. dilation of an occluded vessel using a balloon catheter _____
17. surgery that creates a bypass around a blocked segment of a coronary artery _____
18. removal of occluding material using a cutting or grinding device _____
19. incision or puncture of a vein to remove blood or introduce fluids _____
20. destruction of a blood clot _____



Check your answers in Appendix A. Review any material that you did not answer correctly.

Correct Answers _____ × 5 = _____ % Score

MEDICAL RECORD ACTIVITIES

The two medical records included in the following activities use common clinical scenarios to show how medical terminology is used to document patient care. Complete the terminology and analysis sections for each activity to help you recognize and understand terms related to the cardiovascular system.

Medical Record Activity 8-1

Chart Note: Acute Myocardial Infarction

Terminology

Terms listed in the following table are taken from *Chart Note: Acute Myocardial Infarction* that follows. Use a medical dictionary such as *Taber's Cyclopedic Medical Dictionary*, the appendices of this book, or other resources to define each term. Then review the pronunciations for each term and practice by reading the medical record aloud.

Term	Definition
acute	
cardiac enzymes KĀR-dē-ākĔN-zīmz	
CCU	
ECG	
heparin HĔP-ă-rĭn	
infarction ĭn-FĀRK-shŭn	
inferior	
ischemia ĭs-KĔ-mē-ă	
lateral LĀT-ĕr-ăl	
MI	
myocardial mĭ-ō-KĀR-dē-ăl	
partial thromboplastin time thrŏm-bŏ-PLĀS-tĭn	

Term	Definition
streptokinase strĕp-tō-KĪ-nās	
substernal sŭb-STĔR-nāl	



Listen and Learn Online! *will help you master the pronunciation of selected medical words from this medical record activity. Visit www.davisplus.com/gyls/systems to find instructions on completing the Listen and Learn Online! exercise for this section and to practice pronunciations.*

CHART NOTE: ACUTE MYOCARDIAL INFARCTION

March 15, 20xx

Gately, Mary

PRESENT ILLNESS: Patient is a 68-year-old woman hospitalized for acute anterior myocardial infarction. She has a history of sudden onset of chest pain. Approximately 2 hours before hospitalization, she had severe substernal pain with radiation to the back. ECG showed evidence of abnormalities. She was given streptokinase and treated with heparin at 800 units per hour. She will be evaluated with a partial thromboplastin time and cardiac enzymes in the morning.

PAST HISTORY: Patient was seen in 20xx, with history of an inferior MI in 19xx, but she was stable and underwent a treadmill test. Test results showed no ischemia and she had no chest pain. Her records confirmed an MI with enzyme elevation and evidence of a previous inferior MI.

IMPRESSION: Acute lateral anterior myocardial infarction and a previous healed inferior myocardial infarction. At this time patient is stable, is in coronary care unit, and will be given appropriate followup and supportive care.

PLAN: At this time the patient is stable, is in CCU and will be given appropriate followup and supportive care.

Juan Perez, MD
Juan Perez, MD

D: 03-15-20xx

T: 03-15-20xx

Ibg

Analysis

Review the medical record *Chart Note: Acute Myocardial Infarction* to answer the following questions.

1. How long had the patient experienced chest pain before she was seen in the hospital?

2. Did the patient have a previous history of chest pain?

3. Initially, what medications were administered to stabilize the patient?

4. What two laboratory tests will be used to evaluate the patient?

5. During the current admission, what part of the heart was damaged?

6. Was the location of damage to the heart for this admission the same as for the initial MI?

Medical Record Activity 8-2

Operative Report: Right Temporal Artery Biopsy

Terms listed in the following table are taken from *Operative Report: Right Temporal Artery Biopsy* that follows. Use a medical dictionary such as *Taber's Cyclopedic Medical Dictionary*, the appendices of this book, or other resources to define each term. Then review the pronunciations for each term and practice by reading the medical record aloud.

Term	Definition
arteritis är-tē-RĪ-tīs	
Betadine BĀ-tă-dīn	
biopsy BĪ-öp-sē	
dissected dī-SĔKT-ĕd	
distally DĪS-tă-lē	
incised ĭn-SĪZD	
IV	
ligated LĪ-gā-tĕd	
palpable PĀL-pă-b'1	

Term	Definition
preauricular prē-aw-RĪK-ū-lār	
proximally PRŌK-sī-mă-lē	
superficial fascia soo-pēr-FĪSH-ăl FĀSH-ē-ă	
supine sū-PĪN	
temporal TĒM-por-ăl	
Xylocaine ZĪ-lō-kān	



Listen and Learn Online! *will help you master the pronunciation of selected medical words from this medical record activity. Visit www.davisplus.com/gyls/systems to find instructions on completing the Listen and Learn Online! exercise for this section and to practice pronunciations.*

OPERATIVE REPORT: RIGHT TEMPORAL ARTERY BIOPSY

General Hospital

1511 Ninth Avenue ■■ Sun City, USA 12345 ■■ (555) 8022-1887

OPERATIVE REPORT

Date: May 14, 20xx

Physician: Dante Riox, MD

Patient: Gonzolez, Roberto

Room: 703

PREOPERATIVE DIAGNOSIS: Rule out right temporal arteritis.

POSTOPERATIVE DIAGNOSIS: Rule out right temporal arteritis.

PROCEDURE: Right temporal artery biopsy.

SPECIMEN: 1.5-cm segment of right temporal artery.

ESTIMATED BLOOD LOSS: Nil.

COMPLICATIONS: None.

TIME UNDER SEDATION: 25 minutes.

PROCEDURE AND FINDINGS: Informed consent was obtained. Patient was taken to the surgical suite and placed in the supine position. IV sedation was administered. Patient was turned to his left side and the preauricular area was prepped for surgery using Betadine. Having been draped in sterile fashion, 1% Xylocaine was infiltrated along the palpable temporal artery and a vertical incision was made. Dissection was carried down through the subcutaneous tissue and superficial fascia, which was incised. The temporal artery was located and dissected proximally and distally. Then the artery was ligated with 6-0 Vicryl proximally and distally and a large segment of approximately 1.5 cm was removed. The specimen was sent to the pathology laboratory and then superficial fascia was closed with interrupted stitches of 6-0 Vicryl and skin was closed with interrupted stitches of 6-0 Prolene. A sterile dressing was applied. Patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

Dante Riox, MD
Dante Riox, MD

dr:bg

D: 5-14-20xx

T: 5-14-20xx

Analysis

Review the medical record *Operative Report: Right Temporal Artery Biopsy* to answer the following questions.

1. Why was the right temporal artery biopsied?

2. In what position was the patient placed?

3. What was the incision area?

4. How was the temporal artery located for administration of Xylocaine?

5. How was the dissection carried out?

6. What was the size of the specimen?
