ASSISTING IN CARDIOLOGY

SCENARIO

Adam Stern, CMA (AAMA), has been working for more than 3 years as a medical assistant in a variety of physicians’ offices. Adam recently was hired to work at City Hospital in the cardiology department. His job description includes working in the clinical area of the practice and assisting the attending physicians with patient education and follow-up. Because Adam has never worked for a cardiologist, he is concerned about his knowledge base and competency in cardiac patient care. Part of Adam’s responsibilities will be to help evaluate patient education materials about the warning signs of a heart attack, especially the differences between the symptoms seen in men and those seen in women. The practice also is in the process of updating its policy and procedures manual, and Adam has been asked to create scenarios for telephone screening of patients who call in with symptoms of chest pain.

While studying this chapter, think about the following questions:

- Why is it important that Adam understand the normal anatomy and physiology of the cardiovascular system if he is going to work in a cardiologist’s practice?
- What are some of the common diseases and disorders of the cardiovascular system with which Adam should be familiar?
- What are the common cardiovascular diagnostic procedures that Adam should be prepared to discuss and explain to patients?
- How should he go about developing scenarios for the management of telephone inquiries based on the physicians’ preferences?

LEARNING OBJECTIVES

1. Define, spell, and pronounce the terms listed in the vocabulary.
2. Apply critical thinking skills in performing the patient assessment and patient care.
3. Illustrate the anatomy and physiology of the heart and its significant structures.
5. Describe the signs, symptoms, and medical procedures used in the diagnosis and treatment of coronary artery disease and myocardial infarction.
6. Compare and contrast the treatment protocols for hypertension.
7. Outline the causes and results of congestive heart failure.
8. Illustrate the effects of inflammation and valvular disorders on cardiac function.
9. Describe the anatomy and physiology of the vascular system.
10. Differentiate among the various types of shock.
11. Summarize the characteristics of common vascular disorders.
**Vocabulary**

chordae tendinae (kör'di-ten'ë-din-uh) The tendons that anchor the cusps of the heart valves to the papillary muscles of the myocardium, preventing valvular prolapse.

intermittent claudication Recurring cramping in the calves caused by poor circulation of blood to the muscles of the lower leg.

Marfan syndrome An inherited condition characterized by elongation of the bones, joint hypermobility, abnormalities of the eyes, and the development of an aortic aneurysm.

scleroderma (skluh-rah'der-muh) An autoimmune disorder that affects the blood vessels and connective tissue, causing fibrous degeneration of the major organs.

Cardiac disease, in the past, was frequently seen in men but seldom in women. That has changed, and today the most common cause of illness and death, regardless of gender, is cardiovascular disease. Medical assistants in all specialties often care for patients with heart disorders. Seldom does the cardiologist discover the heart problem. Most patients who see this specialist already have been diagnosed with a suspected heart disorder and were referred to the cardiologist for verification of the initial diagnosis and specialized treatment.

Because of the overwhelming number of people with cardiovascular problems, all medical assistants must understand the cardiovascular system, be able to recognize early symptoms of potential disorders, perform basic screening tests when ordered by the physician, and assist the physician in the examination of the heart and blood vessels.

**ANATOMY OF THE HEART**

The heart is a hollow, muscular organ situated in the thoracic cavity in the mediastinal region, between the right and left pleural spaces. It weighs about 9 ounces and is about the size of a fist; approximately two thirds of it is located to the left of the sternum (Figure 47-1). The heart is a pump that provides the force needed to push blood through all the arteries of the body; the blood circulates a continuous supply of oxygen and nutrients to the cells and picks up the metabolic waste products from them. If deprived of these vital functions, the cells die. At the same time, the heart pushes deoxygenated blood through the pulmonary artery to the lungs for oxygen saturation and receives oxygenated blood back through the pulmonary veins into the left side of the heart. The average adult heart pumps about 5 L of blood every minute. If the heart loses its pumping action for even a few brief minutes, death or permanent damage can result.

**Layers of the Heart**

The heart is enclosed in a double-membrane sac called the pericardium. The outer layer of the pericardial sac, the parietal pericardium, is a tough membrane that connects the heart to the diaphragm and serves as a physical barrier to protect the heart against infection or inflammation from the lungs or pleural space. The inner layer, the visceral pericardium or epicardium, forms the first layer of the heart. Between the two membranes is a small space, the pericardial cavity, which contains about 30 mL of pericardial fluid; this fluid lubricates the internal surfaces of the pericardial membranes, enabling them to slide across each other during heart contractions. The middle layer of the heart, the myocardium, is the muscle layer that constitutes the largest percentage of the heart wall. Contraction of this muscle layer force the blood from the heart into the vessels. The inner layer of the heart, the endocardium, includes the heart valves that separate the chambers of the heart and provide a means of blocking the flow of blood from major blood vessels entering and exiting the heart (Figure 47-2).

**Heart Chambers and Arteries**

The heart is divided into four chambers (Figure 47-3). The atria, the top chambers, receive blood, and the ventricles, the bottom
chambers, pump the blood out. The blood flow through the heart begins in the right atrium, which receives deoxygenated blood from the inferior and superior venae cavae. The atria contract, and blood passes through the tricuspid valve into the right ventricle; the ventricles contract, and blood passes from the right ventricle to the lungs via the pulmonary artery (the only artery in the body that contains deoxygenated blood). Oxygenation occurs in the alveoli of the lungs, and the now oxygenated blood returns to the left atria through the pulmonary veins (the only veins in the body that carry oxygen-rich blood). The atria contract, and blood passes through the mitral (bicuspid) valve into the left ventricle; the ventricles contract, and oxygen-rich blood is sent out to the body through the aorta (the largest artery in the body).

The myocardium requires a continuous supply of oxygen and nutrients, which are delivered through two coronary arteries that branch off the aorta above the aortic valve (Figure 47-4). The right coronary artery nourishes the anterior and posterior myocardium on the right side of the heart, and the left coronary artery does the same on the left side. The left coronary artery quickly divides and forms the left anterior descending artery and the left circumflex artery. Smaller branches of the coronary arteries feed the myocardium and the endocardium. Any interference in blood flow in any of the coronary vessels alters the action of the heart.

Heart Conduction

A sophisticated electrical conduction system operated by specialized cells located at various sites in the myocardium stimulates contractions. These muscle contractions move blood through the chambers of the heart and out through the aorta to the rest of the body. Each electrical impulse passes through the heart muscle in a twisting, spiral motion. These rhythmic waves stimulate the cardiac cells to beat, which causes the heart to contract.

The cardiac impulse originates in specialized muscle tissue called the sinoatrial (SA) node. The SA node rhythmically initiates impulses 70 to 80 times a minute; because it creates the basic rhythm, it is the pacemaker of the heart. It is located in the posterior, superior wall of the right atrium, at the junction of the superior vena cava and the atrium and just above the tricuspid valve. When the SA node discharges its rhythm pattern into the myocardium, it passes across both atria, resulting in atrial contraction and forcing blood through the valves and into the
contraction, recovery, and heart rest. This cycle maintains the average range of 60 to 100 beats per minute and a normal heart rhythm. It is this electrical force that is traced and evaluated when an electrocardiogram (ECG) is done. (Chapter 49 discusses ECGs in more detail.)

**Diseases and Disorders of the Heart**

Many diseases and disorders affect the heart and its blood vessels. Disorders that occur when the rhythm of the heart becomes irregular are addressed in Chapter 49. Cardiac disease has multiple risk factors; some of these cannot be changed, and others people can change or seek to have treated. The more risk factors a person has, the greater his or her risk of developing cardiovascular disease.

**Coronary Artery Disease and Myocardial Infarction**

Coronary artery disease (CAD) causes more than 1 million deaths in the United States every year. In CAD, the formation of atherosclerotic plaques narrows the arteries supplying the myocardium. A plaque originates at the site of a chronic injury to the endothelial lining of the artery caused by risk factors associated with heart disease (e.g., smoking or hypertension). Platelets attach to the site of the endothelial injury, and lipids continue to accumulate. Eventually an atheroma forms, which is made up of a tough collagen shell covering a fatty center that extends out into the lumen of the vessel, restricting blood flow past the plaque. Inflammation at the site attracts platelets to the surface of the atheroma, resulting in the formation of a clot (thrombus) that can completely occlude the lumen of the vessel, depriving the myocardium of an adequate nutritious blood supply (Figure 47-6). The cardinal symptom of myocardial ischemia (holding back of blood) is angina pectoris. Anginal chest pain is pain behind the sternum that is precipitated by exertion but that can be relieved either by rest or by sublingual nitroglycerin.

Patients may be asymptomatic until the disease becomes fully developed. The first symptom may be angina, followed by pressure or fullness in the chest, syncope, shortness of breath, edema, unexplained coughing spells, and fatigue. A patient reporting...
any of these symptoms should be seen by the physician immediately.

In recent years the rate of heart disease has declined in men but not in women. Traditional risk factors negatively affect both genders; however, women are at greater risk if they have metabolic syndrome (a combination of hypertension, elevated insulin levels, excess body fat around the waist, and high blood cholesterol levels); if they have increased levels of stress and/or depression; if they smoke (female smokers are at much greater risk than male smokers); and if they have reduced estrogen production before menopause. The difference in female risks and symptoms is associated with the method of plaque buildup in women; the plaque tends to develop as an evenly spread layer along the entire lumen of the blood vessels rather than as a localized plaque buildup, as is seen in men. Women with heart disease typically experience this diffuse atheroma buildup in smaller vessels, which causes more subtle symptoms than the crushing chest pain associated with classic myocardial infarctions (MIs).

The major concern in heart disease is the lack of blood to the myocardium, which occurs when a vessel becomes totally blocked. Ischemia over a prolonged period leads to necrosis (death) of a portion of the myocardium, resulting in an MI, or heart attack. Symptoms of an MI are similar to those of angina; however, an MI is identified by pain that lasts longer than 30 minutes and is not relieved by rest or nitroglycerin tablets. An MI is a
life-threatening event; intervention must begin within the first hour, or death may occur.

RISK FACTORS FOR HEART DISEASE

Risk Factors That Cannot Be Changed
- **Advancing age**: Most people who die of heart disease are age 65 or older; older women are more likely to die of myocardial infarctions (MIs) than are older men.
- **Gender**: Men are at greater risk of MIs and experience heart attacks earlier in life; women are at greater risk after menopause.
- **Family history and race**: The children of parents with heart disease are more likely to develop it; African-Americans are at greater risk of developing hypertension and heart disease associated with it; Mexican-Americans, Native Americans, native Hawaiians, and some Asian-Americans also are at greater risk.

Lifestyle Risk Factors That Can Be Modified or Treated
- **Smoking**: Male smokers develop heart disease three times more often than women; female smokers develop heart disease six times more often than those who have never smoked. Smoking is associated with sudden cardiac death. Exposure to secondhand smoke also increases the risk.
- **High blood cholesterol**: The risk of heart disease rises with rising blood cholesterol levels.
- **Hypertension**: Hypertension increases the amount of work the heart must do to circulate blood throughout the body.
- **Sedentary lifestyle**: Regular exercise helps prevent cardiovascular disease.
- **Obesity and overweight**: Excess weight, especially increased body fat at the waist, is associated with an increased risk of heart disease and stroke; being as little as 10 pounds can lower the risk.
- **Diabetes mellitus**: The risk of heart disease is even greater if blood glucose levels are not controlled; almost 75% of people with diabetes die of some form of heart or blood vessel disease.


CRITICAL THINKING APPLICATION 47-1
A patient who is scheduled for an appointment in 2 days calls the office and reports that she is not feeling well. She complains that she has a feeling of fullness in the chest, her arms ache, and she is very tired. Although this patient does not have a history of myocardial infarction, what should Adam do?

Diagnostic and Therapeutic Procedures
An MI is diagnosed by ECG changes and elevated cardiac enzymes. The blood test most often ordered to confirm myocardial damage is the creatinine kinase (CK) level. CK levels begin to increase approximately 6 hours after the start of a heart attack and reach their peak in about 18 hours; they return to normal in 24 to 36 hours. The more severe the cardiac damage, the longer it takes for CK levels to peak and then return to normal. Determination of the troponin levels is a more sensitive blood test that can detect minor myocardial damage not evident with CK levels. Troponins increase in the bloodstream within 4 to 6 hours after the initial myocardial damage and peak in 10 to 24 hours. In the case of minor myocardial damage, troponin levels remain elevated up to 10 to 14 days, allowing for later diagnosis of the event. Patients diagnosed with an MI typically are hospitalized immediately, started on oxygen, and continuously monitored by ECG. Additional diagnostic procedures, such as an echocardiogram and heart catheterization, are discussed later in this chapter.

Medical treatment includes the use of thrombolytic medications, such as alteplase (Activase) and reteplase (Retavase), to dissolve coronary artery blockage and prevent permanent myocardial damage. To be most effective, this treatment must be started within 3 hours of the episode; however, it is still helpful if administered within 12 hours of initial symptoms. This timetable makes it extremely important that patients be diagnosed and treated as soon as possible. Thrombolytic medications are administered intravenously (IV) along with heparin to prevent clots that are being dissolved from reforming. Aspirin is used to prevent the formation of blood clots in affected blood vessels. Additional pharmaceutical treatment includes the use of niacin to dilate the coronary arteries so that more blood can be delivered to the myocardium; beta blockers (atenolol [Tenormin], metoprolol [Lopressor], or propranolol [Inderal]) to slow the heart rate and lower blood pressure; anticoagulants (warfarin [Coumadin]) for 3 to 6 months to prevent thrombus formation; and anticholesterol agents (atorvastatin [Lipitor], lovastatin [Mevacor], or simvastatin [Zocor]) to lower blood cholesterol levels and prevent subsequent formation of atherosclerotic plaques.

When the coronary arteries that supply blood to the myocardium have become blocked, or occluded, either percutaneous transluminal coronary angioplasty (PTCA) or coronary artery bypass grafting (CABG) may be indicated. (These surgical procedures are discussed later in this chapter.)

After discharge from the hospital, patients with CAD that has resulted in an MI face multiple lifestyle changes to prevent another episode. Recommendations include no smoking; regular light exercise, such as walking 30 minutes a day, 5 days a week; a diet low in salt, fat, and cholesterol; maintaining a healthy weight; controlling hypertension; reducing stress; and limiting alcohol intake to one or two drinks a day. The medical assistant should be prepared to provide encouragement and reinforce the importance of lifestyle changes to prevent future heart problems. If ordered by the physician, professional referrals to a cardiac rehabilitation program and dietitian can also be helpful.

SIGNS AND SYMPTOMS OF MYOCARDIAL INFARCTION IN WOMEN

In addition to angina, the signs and symptoms of a heart attack in women include the following:
- Abdominal, neck, shoulder, or upper back pain
- Jaw pain
- Shortness of breath
Hypertensive Heart Disease

Chronic elevated blood pressure can result in left ventricular hypertrophy (enlargement), angina, MI, or heart failure. Hypertension also is a major cause of stroke and nephropathy (kidney disease). Some of the risk factors for hypertension include a family history of hypertension or stroke, hypercholesterolemia (high blood cholesterol), smoking, high sodium intake, diabetes, excessive alcohol intake, sedentary lifestyle, obesity, aging, prolonged stress, and race (African-Americans have a higher incidence than Caucasians). Hypertension has an insidious onset, and the patient shows few, if any, signs and symptoms until permanent damage has occurred. Initial symptoms may include general malaise and headache; epistaxis (nosebleed), vertigo, nausea, or syncope can occur with prolonged hypertension.

The two types of hypertension are primary hypertension and secondary hypertension. Secondary hypertension occurs because of a disease process in another body system, such as renal disease or an endocrine disorder. Before secondary hypertension can be properly treated, the underlying disease process must be resolved.

Primary, or essential, hypertension is idiopathic (of unknown cause) and is diagnosed if the patient’s blood pressure is persistently higher than 119 mm Hg systolic and/or 79 mm Hg diastolic at two or more office visits over several weeks or months. If the medical assistant first notes that a patient’s blood pressure is elevated, the pressure should be checked in both arms with the patient seated and after the patient has been standing for at least 2 minutes with a cuff that is the proper size for the patient’s arm.

If the pressure readings are different, the physician uses the higher value for diagnostic purposes. The patient’s blood pressures should be checked again after at least 2 minutes. All of these readings must be documented in the patient’s record. Some patients have “white coat hypertension,” which appears only when they visit the physician. If the patient has a history of this problem, have him or her lie down on the examination table and rest for a few minutes before the blood pressure is taken; this may help in obtaining a more accurate reading (Table 47-1).

The medical assistant can play an important role in antihypertensive therapy by teaching the patient how to take his or her own blood pressure at home, providing literature that reinforces the necessity of monitoring the blood pressure, and helping the patient understand that this condition cannot be cured but can be controlled for the rest of his or her life. Continued encouragement and support are needed, because compliance with the treatment regimen is difficult for a patient who is not showing any symptoms of disease. Table 47-2 summarizes some of the medications that may be prescribed to manage hypertension.

### Telephone Screening for Chest Pain

The medical assistant should activate emergency medical services if the patient reports any of the following:
- Current chest pain that is crushing, pressing, or radiating to the arms, upper back, or jaw
- Sweating, difficulty breathing, nausea, indigestion, or dizziness
- A history of coronary artery disease, myocardial infarction, or angina
- A change in the pattern of the angina
- Chest pain that occurs when resting or with minimum exertion

### Critical Thinking Application 47-3

Essential hypertension is a common problem for patients seen in the cardiology department where Adam works. What could Adam do to help patients with primary hypertension? What informational materials or community resources would be helpful in gaining patient compliance with treatment?
### TABLE 47-2 Medications Used to Treat Hypertension

<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>ACTION</th>
<th>TREATMENT PROTOCOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiazide diuretics</td>
<td>Act on kidneys to increase elimination of sodium and water to reduce blood volume</td>
<td>First drug of choice in hypertensive treatment; enhance the action of other blood pressure (BP) medications; used in patients with diabetes and those with chronic kidney disease with prehypertension</td>
</tr>
<tr>
<td>(Hydrodiuril, Lasix, Lozol, Aldactone)</td>
<td></td>
<td>May be used with a diuretic for stage 1 and stage 2 hypertension</td>
</tr>
<tr>
<td>Beta blockers</td>
<td>Reduce the heart rate and cardiac output; reduce the workload of the heart and open blood vessels</td>
<td>May be used with a diuretic for stage 1 and stage 2 hypertension; also may be used for hypertension in patients with coronary artery disease, heart failure, or kidney failure</td>
</tr>
<tr>
<td>(Tenormin, Lopressor, Ziac, Inderal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angiotensin-converting enzyme (ACE) inhibitors</td>
<td>Cause vasodilation and reduced vascular resistance; reduce the workload of the heart</td>
<td>May be used with a diuretic for stage 1 and stage 2 hypertension; also may be used for hypertension in patients with coronary artery disease, heart failure, or kidney failure</td>
</tr>
<tr>
<td>(Lotesin, Capoten, Vasotec, Monapril, Zestril)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angiotensin II receptor blockers (Cezar, Atacand, Diovan)</td>
<td>Block the action of chemicals that cause vasoconstriction</td>
<td>May be used with a diuretic for stage 1 and stage 2 hypertension; also may be used for hypertension in patients with coronary artery disease, heart failure, or kidney failure</td>
</tr>
<tr>
<td>Calcium channel blockers</td>
<td>Interrupt the movement of calcium into the heart and vessel cells, causing vasodilation</td>
<td>May be used with a diuretic for stage 1 and stage 2 hypertension; also used to treat angina and/or some arrhythmias</td>
</tr>
<tr>
<td>(Norvasc, Lotrel, Cardizem, Procardia, Vascor)</td>
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### Congestive Heart Failure

Congestive heart failure (CHF) occurs when the myocardium is unable to pump an adequate amount of blood to meet the body’s needs. Although the onset can be acute, the condition typically develops over time because of weakness in the left ventricle as a result of chronic hypertension, MI of the ventricular wall, valvular heart disease, or pulmonary complications. Typically, heart failure initially occurs on one side of the heart and then on the other side. Left-sided heart failure usually results from essential hypertension or left ventricular disease, whereas right-sided heart failure can develop as a result of lung disease. Right-sided heart failure that occurs because of pulmonary hypertension associated with chronic obstructive pulmonary disease (COPD) is called cor pulmonale.

In left-sided heart failure, the left ventricle cannot empty completely, and blood backs up in the left atria and ultimately the lungs, resulting in pulmonary edema, or the collection of fluid in the lungs. Signs and symptoms include dyspnea, orthopnea, nonproductive cough, rales, and tachycardia. In right-sided heart failure, the right ventricle cannot maintain complete output, and blood backs up in the right atrium; this prevents complete emptying of the vena cava, resulting in systemic edema, especially in the legs and feet. Both types of heart failure cause fatigue, weakness, exercise intolerance, dyspnea, and sensitivity to cold temperatures.

Nonpharmaceutical treatment for CHF includes limiting physical activity so that the heart does not have to work so hard, restricting salt, not smoking, reducing stress, and controlling weight. Patient education for an individual with CHF must stress the importance of monitoring weight gain, because a sudden increase in weight may indicate fluid retention. Patients should weigh themselves once or twice a week and report any gain of more than 3 pounds to the physician.

Drug therapy for CHF begins with diuretics to treat dyspnea and orthopnea and control edema. Other medications may include an angiotensin-converting enzyme (ACE) inhibitor, a type of vasodilator that widens blood vessels to lower blood pressure and reduce the workload of the heart. Examples of ACE inhibitors include enalapril (Vasotec), lisinopril (Prinivil, Zestril) and captopril (Capoten). Digoxin is prescribed to increase the strength of myocardial contractions, and beta blockers (carvedilol [Coreg] and metoprolol [Lopressor]) are used to slow the heart rate and improve heart function. Because potassium loss is a common side effect of diuretics and digitalis, patients may also be prescribed a potassium (KCl) supplement. Routine monitoring of serum electrolytes is ordered to determine the need for a potassium supplement so that potential complications can be prevented.

### Critical Thinking Application 47-4

Kate Glasgow, a 76-year-old patient with a history of CHF, is in the office today for a checkup. She does not understand why she must stop using salt and start weighing herself regularly at home. What can Adam do to help this patient understand the importance of her treatment regimen?

### Orthostatic Hypotension

Orthostatic, or postural, hypotension is diagnosed if the patient experiences a drop in blood pressure when standing, especially when quickly changing from a prone or seated position to an upright one. When we stand, our blood pressure quickly adapts to the pull of gravity by reflexively increasing the heart rate and constricting systemic arterioles. In a patient with orthostatic hypotension, the blood pressure adjusts sluggishly or not at all to rapid changes in position. An acute episode of orthostatic hypotension may be caused by blood pooling in the lower extremities, a reaction to antihypertensive or antidepressant medication, or prolonged immobility. This is a common problem in elderly people and may contribute significantly to falls and
related injuries. Patients need to be evaluated for secondary causes and encouraged to adjust from a prone position by sitting on the side of the bed for a bit before standing.

To evaluate orthostatic hypotension, the physician may ask the medical assistant to check the patient’s blood pressure while the person is seated, leave the cuff in place, then have the patient stand and immediately check the blood pressure again. Both blood pressure readings should be recorded in the patient’s chart for the physician to evaluate. Include in your note any patient complaints after standing, including dizziness or a feeling of lightheadedness.

**Inflammations and Valvular Disorders**

**Rheumatic Heart Disease**

Rheumatic heart disease develops because of an unusual immune reaction that occurs within 5 weeks after an untreated beta-hemolytic streptococcal infection. The infection starts as “strep” throat or an upper respiratory infection but progresses to the creation of antibodies that react with collagen to cause inflammation in the joints, skin, brain, and heart. During a first rheumatic fever attack, about half of those affected develop heart inflammation, but most have a complete recovery. However, in some people the heart valves are damaged and scars form. The disease process in the heart can involve all layers of heart tissue.

Pericarditis, or inflammation of the outer layer of the heart, causes reduced cardiac activity and pericardial effusion (the collection of blood or fluid in the pericardium). Myocarditis, or inflammation of the muscular lining of the heart, usually is self-limiting but may lead to acute heart failure because of thickening of the myocardial wall. Endocarditis, or inflammation of the inner lining of the heart and the heart valves, is the most common heart complication. Vegetations form along the outer edges of the valve cusps, causing scarring and stenosis and preventing the damaged heart valve from closing or opening completely. The valvular damage may be asymptomatic at first but eventually can cause serious problems. The mitral valve is affected most frequently, which affects the ability of the left ventricle to function normally.

Treatment includes the use of antibiotics (penicillin) to eliminate the streptococcal infection completely and antiinflammatory agents for the inflammatory reaction. In 2007 the American Heart Association changed its guidelines regarding the prophylactic use of antibiotics before a dental or some other invasive procedure. No research links dental, gastrointestinal, or genitourinary tract procedures with the development of endocarditis. Therefore, prophylactic use of antibiotics is now recommended only for patients with the highest risk of complications from endocarditis, such as those with artificial heart valves, or certain types of congenital heart disease.

**Valvular Disorders**

Disorders of the valves of the heart may be caused by a congenital defect or an infection such as endocarditis. Two specific problems can occur with valve disease. The valve can be stenosed, or hardened, which restricts the forward flow of blood, or it can be incompetent, which means that it does not close completely, so blood can leak backward, or regurgitate. The most common valve defect is mitral valve prolapse (MVP), an incompetency in the mitral valve caused by a congenital defect or vegetation and scarring from endocarditis.

Valve disorders ultimately can lead to ventricular hypertrophy and cardiomegaly (enlargement of the heart). Severely damaged valves or serious congenital defects may necessitate surgical replacement of the affected valve.

**BLOOD VESSELS**

Blood vessels are divided into two systems that begin and end with the heart (Figure 47-7). The pulmonary system carries deoxygenated blood from the right ventricle to the lungs and oxygenated blood back to the left atrium. The systemic system carries blood from the left ventricle throughout the entire body and back to the right atrium. The vessels are classified according to their structure and function: arteries carry oxygenated blood away from the heart; capillaries are the microscopic vessels responsible for the exchange of oxygen and carbon dioxide in the tissues; and veins are the vessels that carry deoxygenated blood back to the heart.

**Arteries**

All arteries except the pulmonary artery carry oxygenated blood away from the heart to all the cells of the body. The largest of these vessels is the aorta, which starts at the left ventricle and travels through the center of the body into the lower abdomen where it bifurcates into the right and left femoral arteries with arteries branching off this system down to the feet. As the aorta passes through the body, arteries branch off from it into smaller and smaller vessels, which ultimately become microscopic. These vessels are called arterioles, which terminate into tissue capillaries, the smallest and most plentiful of the blood vessels. Capillaries are a single epithelial cell thick so that nutrients and gases can pass through the vessel wall for exchange at the cellular level. Arterioles deliver erythrocytes (red blood cells [RBCs]), which carry oxygen attached to hemoglobin molecules to surrounding tissues. When the blood leaves the capillary bed, the oxygen supply has been depleted, and the return portion of the blood cycle now begins.

**Veins**

As the blood leaves the capillary beds, it enters the smallest veins, called venules. From this point on, the blood flows into larger and larger veins until it reaches the largest veins in the body, the inferior and superior venae cavae. The venae cavae deposit deoxygenated blood into the right atrium, where the blood again begins its trip through the heart through the tricuspid valve, into the right ventricle then through the pulmonary arteries to the lungs, where gas exchange occurs at the alveoli level. Oxygen-rich blood is returned to the left atrium via the pulmonary veins. The walls of veins are thinner than those of arteries because they do not have a muscular lining. Instead, veins have valves that open and close to prevent the backflow of blood. The valves operate by the contraction of muscles around the veins; these contractions
massage the blood in the direction of venous flow back to the heart. Venous valves are especially important in the arms and legs, because they prevent pooling of blood in the extremities.

### Vascular Disorders

The vascular system constantly supplies blood containing oxygen and nutrients to all the body's tissues and picks up waste from tissue metabolism. For tissues to receive an adequate amount of oxygen and nutrients, the arterial vessels must maintain elasticity, and their linings must remain smooth to prevent occlusion and reduced blood flow.

#### Shock

Shock can occur in many different situations (Table 47-3), but they all result in the same signs and symptoms and possible complications. Shock is the general collapse of the circulatory system, including reduced cardiac output, hypotension, and hypoxemia (decreased oxygen in the blood). The initial signs of shock are extreme thirstiness, restlessness, and irritability. The body attempts to compensate for circulatory collapse with constriction of peripheral blood vessels, allowing blood to pool in the vital organs. This vasoconstriction causes a generalized feeling of cool, clammy skin; pallor; tachycardia; and reduced urinary output. Symptoms progress to a rapid, weak, thready pulse; tachypnea; and altered levels of consciousness. If the process is not reversed, the central nervous system becomes depressed, and acute renal failure may occur.

The cause of the shock must be treated for the patient to survive. If the medical assistant identifies a patient in shock, emergency treatment should be started at once. Do not wait for the first indicators of shock to worsen before calling for help. If the physician is not available, call 911 for emergency medical care. Place the patient in a supine position, assess the vital signs frequently, keep the patient warm, administer oxygen, and elevate the legs (if there is no indication of head or neck trauma) to encourage the flow of blood back to the heart.

#### Vein Disorders

### Varicose Veins

Varicose veins are dilated, tortuous, superficial veins in the legs (Figure 47-8). Varicosities can be caused by congenitally defective valves in the saphenous veins and the veins branching off them. Other contributing factors are pregnancy, obesity, prolonged standing or sitting, and heavy lifting. Whatever the cause, the vein valves do not close completely; this allows blood to flow backward, causing the vein to distend from the increased pressure.

Treatment includes consistent aerobic exercise and limiting heavy lifting. The legs should be elevated when possible, and support stockings should be worn by those who must stand for long periods. Varicose veins may need surgical intervention, which consists of laser treatments, saline injections, or surgical ligation and stripping. Although treatment may be successful, varicosities can recur over time. Patients should be warned to investigate insurance coverage of treatment costs, because many insurance companies consider treatment of varicose veins cosmetic surgery. However, if the patient has documented proof of a health risk associated with the varicosities, insurance companies are more likely to pay for treatment.

![Varicose veins of the calf. (From Damjanov I: Pathology for the health-related professions, ed 3, St Louis, 2006, Saunders.)](image)

### TABLE 47-3 Types and Causes of Shock

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DEFINITION</th>
<th>CAUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiogenic</td>
<td>Low cardiac output caused by inability of the heart to pump</td>
<td>Acute MI, arrhythmias, pulmonary embolism, CHF</td>
</tr>
<tr>
<td>Hypovolemic</td>
<td>Excessive loss of blood or body fluids</td>
<td>GI bleeding, internal or external hemorrhage, excessive loss of plasma or body fluids, burns</td>
</tr>
<tr>
<td>Neurogenic</td>
<td>Peripheral vascular dilation resulting from neurologic injury or disorder</td>
<td>Spinal cord injury, emotional stress, drug reaction</td>
</tr>
<tr>
<td>Anaphylactic</td>
<td>Systemic hypersensitivity to an allergen, causing respiratory distress and vascular collapse</td>
<td>Drug, vaccine, shellfish, nuts, insect venom, chemical, allergies</td>
</tr>
<tr>
<td>Septic (septicemia)</td>
<td>Systemic vasodilation caused by the release of bacterial endotoxins</td>
<td>Systemic infection or bacteremia</td>
</tr>
</tbody>
</table>

CHF, Congestive heart failure; GI, gastrointestinal; MI, myocardial infarction.
Deep Vein Thrombosis

Phlebitis is an inflammation of a vein, most commonly seen in the lower legs. When a vein becomes inflamed, a blood clot, or thrombus, may develop at the site. A thrombus is a clot formed by the collection of platelets that attaches to the interior wall of a vessel. Deep vein thrombosis (DVT) is a thrombus with inflammatory changes that has attached to the deep venous system of the lower leg, causing partial or complete obstruction of the vessel. The calf veins are the most common sites of DVT, but it also can develop in the iliac and femoral veins. Risk factors for the formation of a DVT are recent surgery, immobilization, older age (an increase in risk is seen after age 50), trauma, obesity, use of oral contraceptives, varicose veins, pancreatic cancer, and pregnancy.

In the early stages, approximately 50% of patients with DVT are asymptomatic. Some patients complain of calf pain or cramping and edema of the affected leg, with warmth and erythema at the site. A thrombus that dislodges and begins to move through the general circulation is called an embolus. A pulmonary embolism (PE), which is a thrombus that breaks loose and is carried to the lungs, causing blockage of a pulmonary artery, is the most serious complication and may be the first indication that the thrombus was present. Signs and symptoms of PE include an acute onset of chest pain that worsens with a deep breath or cough; unexplained shortness of breath; vertigo or syncope; hemoptysis; and a feeling of anxiety. Patients with any of these indicators should seek immediate medical attention.

DVT is typically diagnosed with venous Doppler studies, which use ultrasound to measure the rate of blood flow through the vessel and can accurately detect venous obstruction. Ultrasound can be used to create an image of the blood flow through the targeted vessel, allowing visualization of the thrombus. Venography also may be ordered; in venography a dye is injected into a large vein of the foot or ankle and x-ray films of the veins are taken. Once the diagnosis has been confirmed, patients usually are hospitalized for IV anticoagulant therapy (heparin) or enoxaparin sodium (Lovenox) SC injections. Anticoagulant therapy does not dissolve existing clots but prevents clots from increasing in size and reduces the potential for additional clots. Oral anticoagulant treatment (warfarin [Coumadin]) is continued for several months. Patients require regular follow-up, including prothrombin time analysis. The medical assistant may perform venipuncture on these patients, and if so, should follow the office policy for blood draws on patients taking anticoagulants. The medical assistant should also reinforce the physician’s recommendations regarding the prevention of further thrombi and precautions about anticoagulant use.

PATIENT EDUCATION FOR PREVENTION OF DEEP VEIN THROMBOSIS

- Take your prescribed medications as directed.
- If you have been prescribed anticoagulants, eat foods high in vitamin K in small amounts (e.g., dark green, leafy vegetables, canola and soy oils).
- Avoid sitting still for long periods; walk around several times during the day or move your legs frequently.
- Alter lifestyle factors such as obesity, smoking, and hypertension, because they increase the risk of DVT.
- Wear compression stockings as ordered by the physician.

CRITICAL THINKING APPLICATION 47-5

Alliza Lincoln, a 43-year-old patient, has large varicose veins in both legs and a history of phlebitis. She is a checkout clerk at the local Wal-Mart, so she stands for extended periods. The physician is concerned about the development of a DVT, and she instructs Ms. Lincoln in the prevention, signs, and symptoms of a thrombus. Ms. Lincoln asks Adam what she can do to prevent further problems with the veins in her legs. Adam uses a picture to illustrate the valves in the leg veins and explains preventive measures. What measures should Adam include?

Arterial Disorders

Atherosclerosis and Atherosclerosis

Atherosclerosis is a general term for the thickening and loss of elasticity of the arterial walls that is associated with aging. Other conditions that can lead to hardening of the arterial wall are hypertension, scleroderma, and diabetes mellitus. Atherosclerosis can occur in arteries throughout the body and causes systemic ischemia and necrosis over time.

Atherosclerosis is a form of atherosclerosis marked by the formation of an atheroma, a buildup of cholesterol, cellular debris, and platelets along the inside vessel wall (Figure 47-9). (Cholesterol was discussed in Chapter 30, with recommendations for high-density lipoprotein [HDL] and low-density lipoprotein [LDL] levels.) Cholesterol is a nonessential nutrient that can be produced in the liver and that forms the base for many of the hormones created in the body. Problems arise from dietary and lifestyle factors that elevate blood cholesterol levels to a dangerous point, causing the formation of atheromas, which ultimately block arteries and cause such disorders as heart attacks and strokes.

Treatment of elevated blood cholesterol levels consists of dietary reductions in saturated fats and foods high in cholesterol, as well as aerobic exercise to elevate HDL levels. Patients are encouraged to stop smoking. Statin drugs, such as atorvastatin (Lipitor) and simvastatin (Zocor), may be used to control or reverse plaque buildup. The medical assistant can help by educating the patient about risk factors and promoting changes in lifestyle. Referrals to a dietitian may be helpful for patients having a difficult time controlling their fat intake.

Aneurysm

An aneurysm is a ballooning or dilation of a blood vessel wall (Figure 47-10). The patient may have an inherited factor for the development of aneurysms, such as in Marfan syndrome, but a common cause is the buildup of atherosclerotic plaques, which weaken the vessel wall. Aneurysms can occur in any artery but usually develop in either the abdominal aorta or the cerebral arteries. In either case, the patient seldom has any signs or symp-
especially in the legs. Plaque deposits reduce the size of the lumen of the blood vessel, thereby reducing the amount of oxygenated blood delivered to the tissues. This lack of oxygen causes symptoms, most notably leg pain when walking, a condition called **intermittent claudication**. Other signs and symptoms of peripheral arterial disease are leg numbness or weakness; persistently cold extremities; sores on the feet or legs that do not heal; and hair loss on the extremities. The most effective treatments for intermittent claudications are regular exercise and smoking cessation. Bypass surgery or angioplasty may be necessary if exercise does not improve blood flow to tissues.

### Diagnostic Procedures and Treatments

The cardiovascular examination begins with the medical assistant obtaining the patient's height and weight, temperature, radial and apical pulses, respirations, and blood pressure in both arms. Most cardiologists also want a complete list of the prescription and over-the-counter medications the patient is taking, including the strength and frequency of use for each. A large part of the physician's examination focuses on subjective symptoms. The physical examination covers the chest, heart, and vascular systems. General appearance, color of the skin, symmetry, clubbing of the fingers, jugular vein distention, temperature of the extremities, and breathing patterns are a few of the notations made by the cardiologist.

A very common diagnostic test for the cardiovascular system performed in the ambulatory care setting is the electrocardiogram, which records the electrical activity of the heart. An ECG is a routine part of many physical examinations, and it also may be ordered if the physician is trying to rule out an MI or to diagnose a cardiac arrhythmia. (ECG techniques and interpretations are covered in detail in Chapter 49.) If the physician wants to evaluate potential cardiac problems in patients over a specific period, a Holter monitor may be ordered. The Holter monitor is worn for a specified time (usually 24 hours), and the patient is instructed to record any symptoms that occur during this period. (Holter monitoring also is discussed in Chapter 49.)

Patient support and education are two very important areas in which medical assistants are deeply involved. When patients understand their condition and are encouraged to take an active role in their treatments, they are inclined to comply with the physician's orders in a more precise and orderly way. Although cardiovascular diagnostic procedures are not typically done in the ambulatory care setting, medical assistants should be familiar with the purpose of the tests so that they can answer patients' questions knowledgeable.

### Doppler Studies

Doppler studies can identify occlusions of both veins and arteries from thrombi, emboli, or atherosclerotic plaques. The physician may order arterial Doppler studies for patients with intermittent claudication, lack of a pedal pulse, or leg ulcers that refuse to heal. Venous sonography is ordered to assess patients with pronounced varicosities or those with a swollen, painful leg to rule out the possibility of DVT. For a continuous wave Doppler study, a conductive gel is applied to the skin over the test site.
Doppler transducer is moved over the site, directing an ultrasound beam at the vessel being checked (Figure 47-11). The sonographic beam picks up the speed of the RBCs as they travel through the vessel as a “swishing” sound. The physician listens to the change in the pitch of the sound produced by the transducer to evaluate the blood flow through an area that may be blocked or narrowed. Variations in RBC velocity indicate either partial or complete occlusion of the blood vessel. A two-dimensional image of an artery can be produced with a duplex Doppler scan that directly shows stenosis or occlusion of the artery. These studies usually are conducted in a vascular laboratory but may be done in a vascular surgeon’s office as an initial assessment of the patient or follow-up after bypass grafting. The medical assistant working in this type of practice requires additional training to perform this procedure.

Angiography

Angiography (arteriography) can be used to evaluate any of the arterial pathways in the body (Figure 47-12). A catheter is inserted into a major artery (usually the femoral artery) and advanced to the artery under study. A radiopaque contrast medium is rapidly injected while x-ray films are taken. The study is used to identify abnormal blood vessels, determine blood flow through the vessel, and diagnose arterial anomalies. Angiography also can be used to identify and locate occlusions of the aorta and arteries of the lower extremities. If the radiopaque substance does not pass through or only partially passes through the vessel, the distal end of the artery will not be visualized or will be only partly visible on the x-ray films. Arteriosclerotic disease can create a total or partial occlusion; emboli typically cause total occlusion of the artery. The study also can diagnose dilation of a vessel caused by an aneurysm.

Echocardiography

Echocardiography is a noninvasive, sonographic procedure that assesses the structure and movement of the various parts of the heart. High-frequency sound waves from a transducer held against the chest wall penetrate the heart. The sound waves bounce off the heart and echo back through the transducer into the machine, where they are converted into a picture that shows the exact size and movement of the parts of the heart being measured. Two-dimensional echocardiography also can be done to provide a spatial picture of the anatomic structures of the heart. Echocardiography usually includes color Doppler studies to show the pattern and velocity of blood flow within the heart and in the great vessels. Backflow of blood, as with a valve that is incompetent, can be identified by changes in color.

A transesophageal echocardiogram (TEE) uses a long tube with a microphone-like device mounted on one end that the patient swallows into the esophagus. Once in place, the device is very close to the heart, and sound waves emitted by the microphone create high-quality views of the heart and heart valves. Before the patient swallows the device, the mouth and throat are sprayed with medication that numbs the area. The patient may be given a sedative to help him or her relax and remain still during the procedure. Echocardiography is used to diagnose pericardial effusion, valvular heart disease, aneurysms, and myocardial wall abnormalities seen in CHF or MI.

Cardiac Catheterization and Angioplasty

Cardiac catheterization is used to diagnose or evaluate a variety of heart disorders. Patients who have chronic shortness of breath, vertigo or syncope, chest pain, heart palpitations, arrhythmias, or abnormal stress test or echocardiography results or who have recently had an MI all are considered likely candidates for a heart catheterization procedure.

In this procedure, a catheter is passed into the heart through a peripheral vein or artery. If the right side of the heart is to be evaluated, the catheter usually is passed through the subclavian, brachial, or femoral vein; for left-sided views, the right femoral artery usually is used. As the catheter is passed through the vessels into the heart and coronary arteries, pressures are monitored, oxygen levels are measured, and cardiac output is determined. Once the catheter has reached the desired position, a contrast
medium is injected and fluoroscopy is used to visualize the heart chambers, valves, and coronary arteries. The cardiologist evaluates the condition of these structures, and any deviation from normal is noted. Cardiac catheterization is performed in a hospital and usually takes 2 to 3 hours. Patients are required to remain immobile and under observation for 4 to 6 hours after the procedure.

During a heart catheterization procedure, if atherosclerotic plaques are discovered to be occluding the coronary arteries, PTCA may be performed. The goals of angioplasty are to restore blood flow to ischemic myocardial tissue, reduce the need for cardiac medication, and eliminate or reduce the number of episodes of angina. When the area of plaque is found, a balloon that surrounds the upper portion of the catheter is inflated and the atherosclerotic material is pressed against the vessel walls, relieving the obstruction. More than one blockage can be treated during a single session, depending on the location of the blockages and the patient's condition. The procedure can take 30 minutes to several hours, depending on the number of blockages treated.

Lasers also may be used to dissolve the obstruction, or a coronary arterial stent, which is a mesh wire that stretches and molds to the arterial wall, may be inserted and left in place in the vessel to keep it open (Figure 47-13). If multiple coronary artery occlusions are present, the patient may need a CABG procedure. In this surgery, either part of the saphenous vein or an artificial Dacron graft is used to bypass the occluded, diseased section of the coronary artery. The blood flows through the graft to bring nourishment to the ischemic myocardium.

Cardiac Pacemakers
A cardiac pacemaker is a small, battery-powered device that is implanted in the chest wall to generate an electrical impulse, which is sent to the heart along flexible lead wires (Figure 47-14). Current pacemakers are designed to monitor several different types of data, including the patient's blood pressure, temperature, and breathing rate to determine whether the heart needs to be stimulated to contract more frequently. Patients who require the external electrical stimulation of a pacemaker have an arrhythmia (most often bradycardia) either because of injury to the myocardium or as a consequence of the aging process. Biventricular pacemakers, which deliver electrical impulses to both of the ventricles so that they contract and empty at the same time, are the most recent types.

Pacemakers continually get smaller, from the size of a pack of cigarettes in previous years to models that now are as small as a quarter. The pacemaker must be replaced when the battery pack wears out, and the typical battery life ranges from 5 to 10 years.

Implantable Cardioverter-Defibrillator
An implantable cardioverter-defibrillator (ICD) is a pager-size device implanted in the chest under the skin and attached to the heart with small wires. It continuously monitors the heart rhythm and is designed to deliver a measured electric shock to the myocardium to correct life-threatening arrhythmias, such as ventricular tachycardia or ventricular fibrillation. ICDs have become the

FIGURE 47-13 Angioplasty with stent placement. (From Lafleur Brooks: Explaining medical language, ed 7, St Louis, 2008, Mosby.)

FIGURE 47-14 Pacemaker and placement in the chest. (From Asherlin B: Paramedic practice today: above and beyond, St Louis, 2009, Mosby/Elsevier.)
standard treatment for any patient with a serious arrhythmia who is at risk of sudden death from cardiac arrest.

**CLOSING COMMENTS**

**Patient Education**

Heart disease and stroke account for more than one third of all deaths in the United States. Genetics, predisposition, and lifestyle factors, such as smoking, lack of exercise, and poor diet, play significant roles in the development of heart disease. Successful management of cardiovascular disease requires major lifestyle changes for most patients. The medical assistant can help by providing encouragement and support and by using community resources to help the patient find assistance with these changes.

Sources for information include the American Heart Association (www.americanheart.org); workshops and conferences; professional organizations, such as the American Association of Medical Assistants (AAMA); and reputable Internet sites.

Because many patients learn best through visual aids, providing them with pictures, brochures, and pamphlets is an effective means of helping them in this learning process. Always document education interventions so that, if necessary, the physician and/or medical assistant can clarify or expand upon the information on a return visit.

**Legal and Ethical Issues**

Diagnostic procedures can have a marked effect on the patient’s treatment. When entrusted with performing testing procedures, the medical assistant assumes responsibility for the test’s accuracy and for performing the test precisely. This is an important role, because the results submitted could strongly influence the plan of treatment.

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**SUMMARY OF SCENARIO**

Adam enjoys his new position but recognizes the challenges of interacting with patients who have cardiovascular problems. Most individuals seen at the clinic must make significant changes in their lifestyle to improve their health or prevent further complications. Adam has found it difficult at times to help patients who refuse to quit smoking, who do not exercise regularly, and who continue to eat a diet high in fat. He relies on the hospital dietitian for educational support, and he encourages patients who have had an MI to follow the cardiologist’s advice and participate actively in the cardiac rehabilitation program offered by the department. He also works hard to stay up-to-date on cardiovascular medications and treatments, because so many of the department’s patients have complicated therapeutic plans.

Adam has attended several workshops recently to help him choose patient education materials that meet the needs of the patients in his practice. With the approval of the practice’s physicians, he has developed a basic policy and procedures manual for managing common telephone scenarios. He recognizes the need to continue his education in the area of cardiology to stay current with the rapid developments in medication and treatments.

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**SUMMARY OF LEARNING OBJECTIVES**

1. Define, spell, and pronounce the terms listed in the vocabulary. Spelling and pronouncing medical terms correctly bolster the medical assistant’s credibility. Knowing the definitions of these terms promotes confidence in communication with patients and co-workers.

2. Apply critical thinking skills in performing the patient assessment and patient care. Completing the Critical Thinking Application exercises throughout the chapter can help the student medical assistant become more adept at critical analysis of real-life situations.

3. Illustrate the anatomy and physiology of the heart and its significant structures. The heart is a muscular organ that pumps blood through all the arteries of the body. It has three layers of tissue surrounded by a double-membrane sac (the pericardium): the epicardium, or first, layer; the myocardium, the middle, muscular layer, and the endocardium, the inner layer, which forms the heart valves. Blood flow through the heart begins in the right atrium, which receives deoxygenated blood from the inferior and superior vena cavae. The atria contract, and blood passes through the tricuspid valve into the right ventricle; the ventricles contract, and the blood passes from the right ventricle to the lungs via the pulmonary artery. Oxygenation occurs in the lungs, and the blood returns to the left atria through the pulmonary veins; the atria contract, and blood passes through the mitral (bicuspid) valve into the left ventricle; the ventricles contract, and oxygen-rich blood is sent out to the body through the aorta.

4. Summarize risk factors for the development of cardiovascular disease. Risk factors for the development of cardiovascular disease that cannot be changed are familial history, aging, and race; factors that can be altered are hypertension, diabetes, elevated blood cholesterol levels, smoking, obesity, lack of exercise, and stress.

5. Describe the signs, symptoms, and medical procedures used in the diagnosis and treatment of coronary artery disease and myocardial infarction. In CAD, the arteries supplying the myocardium become narrowed by atherosclerotic plaque, resulting in ischemia of the myocardium. The cardinal symptom is angina pectoris, followed by pressure or fullness in the chest, syncope, unexplained coughing spells, and fatigue; however, women may have a different clinical picture. Ischemia leads to necrosis of a portion of the myocardium, resulting in an MI. An MI is characterized by pain that lasts longer than 30 minutes and is unrelieved by rest or
nitroglycerin tablets. It is diagnosed by ECG changes and elevated cardiac enzymes. Medical treatment includes thrombolytic medications, aspirin, beta blockers, ACE inhibitors, anticoagulants, and anticholesterol agents. With occlusion, either PTCA or CABG surgery may be indicated.

6. Compare and contrast the treatment protocols for hypertension.

The two types of hypertension are primary and secondary hypertension. Secondary hypertension occurs because of a disease process in another body system. Primary hypertension is idiopathic and is diagnosed when the patient’s blood pressure is consistently above 119 mm Hg systolic and/or 79 mm Hg diastolic. Table 47.1 summarizes the varying stages of hypertension and lists antihypertensive medications. Chronic elevated blood pressure can result in left ventricular hypertrophy, angina, MI, heart failure, cerebrovascular accident, and nephropathy. Risk factors for hypertension include a family history of hypertension or stroke, hypercholesterolemia, smoking, high sodium intake, diabetes, excessive alcohol intake, aging, prolonged stress, and race.

7. Outline the causes and results of congestive heart failure.

CHF occurs when the myocardium is unable to pump an adequate amount of blood to meet the body’s needs. It typically develops over time and initially involves one side of the heart and then the other side. Left-sided heart failure causes a backup of blood in the left atria and lungs, resulting in pulmonary edema with dyspnea, orthopnea, nonproductive cough, rales, and tachycardia. Right-sided heart failure causes a backup of blood in the right atrium, preventing emptying of the vena cava, resulting in systemic edema, especially in the legs and feet. Both types of heart failure cause fatigue, weakness, exercise intolerance, dyspnea, and sensitivity to cold temperatures.

8. Illustrate the effects of inflammation and valvular disorders on cardiac function.

Rheumatic heart disease develops because of an unusual immune reaction that occurs approximately 2 weeks after an untreated beta-hemolytic streptococcal infection; endocarditis is the most common heart complication, with valvular damage. Disorders of the heart valves may be caused by a congenital defect or an infection. Two specific problems can occur with valve disease. The valve can be stenosed, which restricts the forward flow of blood, or it can be incompetent, which allows blood to leak backward. The most common valvular defect is MVP, which results from a congenital defect or vegetation and scarring caused by endocarditis.

9. Describe the anatomy and physiology of the vascular system.

Blood vessels are divided into two systems that begin and end with the heart. Vessels are classified according to their structure and function as arteries, which carry oxygenated blood away from the heart; capillaries, the microscopic vessels responsible for the exchange of oxygen and carbon dioxide in the tissue; and veins, the vessels that carry deoxygenated blood back to the heart.

10. Differentiate among the various types of shock.

Table 47.3 outlines the various types of shock. All result in the same signs and symptoms and possible complications. Shock is the general collapse of the circulatory system, marked by reduced cardiac output, hypotension, and hypoxemia. Symptoms progress to a rapid, weak, thready pulse; tachypnea; and altered levels of consciousness. If the process is not reversed, the central nervous system becomes depressed and acute renal failure may occur.

11. Summarize the characteristics of common vascular disorders.

Varicose veins are dilated, tortuous, superficial veins in the legs that develop because the valves no not completely close, allowing blood to flow backward, thus causing the vein to distend from the increased pressure. Phlebitis is an inflammation of the veins most commonly seen in the lower legs. DVT is a thrombus with inflammatory changes that has attached to the deep venous system of the lower legs and has caused a partial or complete obstruction of the vessel. A thrombus that dislodges and begins to circulate through the general circulation is an embolus. Arteriosclerosis is a general term for the thickening and loss of elasticity of arterial walls; it can occur in arteries throughout the body and cause systemic ischemia and necrosis over time. Atherosclerosis is a form of arteriosclerosis in which an atheroma develops. An aneurysm is a ballooning or dilatation of the wall of a vessel caused by weakening of the vessel wall. Peripheral arterial disease affects the vessels outside of the heart, especially the legs and feet, in which circulation is reduced and ischemia can occur.


Cardiovascular diagnostic procedures include Doppler studies of the pressure of blood vessels; angiography to visualize arterial pathways; echocardiography to assess the structure and movement of the parts of the heart, especially the valves; and cardiac catheterization to show the heart chambers, valves, and coronary arteries.

CONNECTIONS

Study Guide Connection: Go to the Chapter 47 Study Guide. Read and complete the activities.

Evolve Connection: Go to the Chapter 47 link at evolve.elsevier.com/kimm to complete the Chapter Review and Chapter Quiz. Peruse other resources listed for this chapter to increase your knowledge of Assisting in Cardiology.