

The Cardiovascular System

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Objectives

Upon completing this chapter, you should be able to:

Theory

1. Describe the normal anatomy and physiology of the cardiovascular system.
2. Discuss the risk factors and incidence of cardiovascular disease.
3. Explain ways to modify risk factors for the development of cardiovascular disease.
4. State ways in which nurses can contribute to the prevention of cardiovascular disease.
5. Describe the diagnostic tests, specific techniques, and procedures for assessing the cardiovascular system.
6. Identify three likely nursing diagnoses for patients who have common problems of cardiovascular disease and list the expected outcomes and appropriate nursing interventions for each.

Clinical Practice

1. Teach patients about the more common diagnostic tests and procedures to diagnose and evaluate cardiovascular diseases.
2. Assist patients to form plans to modify cardiovascular disease risk factors.

Key Terms



Be sure to check out the bonus material on the Companion CD-ROM, including selected audio pronunciations.

arteriosclerosis (ă-r-tē-rē-ō-sklē-RŌ-sīs, p. 00)
cardiomyopathy (kār-dē-ō-mī-ŌP-ăth-ē, p. 00)
cellulitis (sēl-ŭ-LĪ-tīs, p. 00)
coarctation (kō-ărk-TĀ-shŭn, p. 00)
dysrhythmia (dĭs-RĪTH-mē-ă, p. 00)
endocarditis (ĒN-dō-kăhr-DĪ-tīs, p. 00)
hypertension (hī-pēr-TĒN-shŭn, p. 00)
intermittent claudication (in-tēr-MĪT-ēt klaw-dī-KĀ-shŭn, p. 00)
ischemia (is-KĒ-mē-ă, p. 00)
oscilloscope (ōz-ĪL-ō-skōp, p. 00)
palpitation (pāl-pī-TĀ-shŭn, p. 00)
pericarditis (pēr-ē-kăhr-DĪ-tīs, p. 00)
rubor (rōō-bôr, p. 00)
sympathectomy (SĪM-pă-th-ĒK-tō-mē, p. 00)
syncope (SĪN-kō-pē, p. 00)

Cardiovascular disease (CVD) affects one in three people in the United States. The death rate from heart disease has seen a steady decline since 1979, but the rate has begun again to climb. More than 600,000 people die in the United States as a result of cardiovascular problems each year. Preventing and controlling cardiovascular disease are major factors in the attempt to control health care costs. Cardiovascular disease is responsible for the largest portion of Medicare funds spent each year. Each nurse can be instrumental in educating the public regarding prevention and in promoting a heart-healthy lifestyle.

Heart disease in women has been increasing. Nearly 39% of all female deaths in the United States occur from CVD. It is the number one killer of women. Low blood levels of “good” cholesterol (high-density lipoprotein, or HDL) appear to be a stronger predictor of heart disease in women than in men, particularly in the over-65 age group. High blood levels of triglycerides are another particular risk factor in women (Health Promotion Points 17–1). Where it was once thought that hormone replacement therapy (HRT) was heart protective, it was discovered that there were more cardiovascular events in women who were on HRT (Hlatky et al., 2002).



To understand the various disorders of the cardiovascular system, it is necessary to recall the structure and normal functions of the heart and blood vessels.

Together with the heart, the vascular system provides the body with nutrients and oxygen needed for life. It also transports metabolic wastes that are excreted by the lungs and the kidneys. When a disorder of the cardiovascular system occurs, homeostasis is upset. Many of the disorders that afflict the cardiovascular system can be prevented or controlled. The public must be educated about the risk factors for the various peripheral vascular and cardiac disorders and about lifestyle changes that may decrease those risks.

The peripheral blood vessels are those situated some distance from the heart. Disorders of the peripheral veins and arteries are almost always chronic, affect people in older age groups, and are associated with other diseases of the cardiovascular system. For example, atherosclerosis affects both the aorta and the arteries

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OVERVIEW OF ANATOMY AND PHYSIOLOGY

What are the structures of the heart and their functions?

- The heart wall consists of three layers. The epicardium is the outer layer of tissue; the myocardium is the middle layer of muscle fibers that contract to pump blood, and the endocardium is the lining of the inner surface of the heart chambers.
- A membranous sac, the pericardium, surrounds the heart.
- The pericardium is a double-layered sack. It helps provide a barrier to infection and helps prevent overfilling of the heart.
- The pericardial space contains a thin layer of fluid (5 to 20 mL).
- The four chambers of the heart make up two coordinated pumps: the right-side pump is a low-pressure system; the left-side pump is a high-pressure system.
- The right atrium and right ventricle receive deoxygenated blood from the vascular system and pump it through the lungs.
- The left atrium and left ventricle receive oxygenated blood from the lungs and pump it through the systemic circulation.
- A septum separates the right and left sides of the heart.
- The cardiac valves direct the flow of blood through the heart chambers.
- Blood enters the right atrium via the superior and inferior vena cava and goes to the right ventricle through the tricuspid valve.
- Blood leaves the right ventricle through the pulmonic valve and goes into the pulmonary artery to circulate in the lungs, exchanging carbon dioxide for oxygen. Other arteries in the body carry oxygenated blood.
- The left atrium receives oxygenated blood from the pulmonary veins, and the mitral valve controls the flow from the atrium into the left ventricle. Other veins in the body carry blood containing carbon dioxide.
- The left ventricle ejects the blood through the aortic valve into the aorta and the systemic circulation (Figure 17–1).

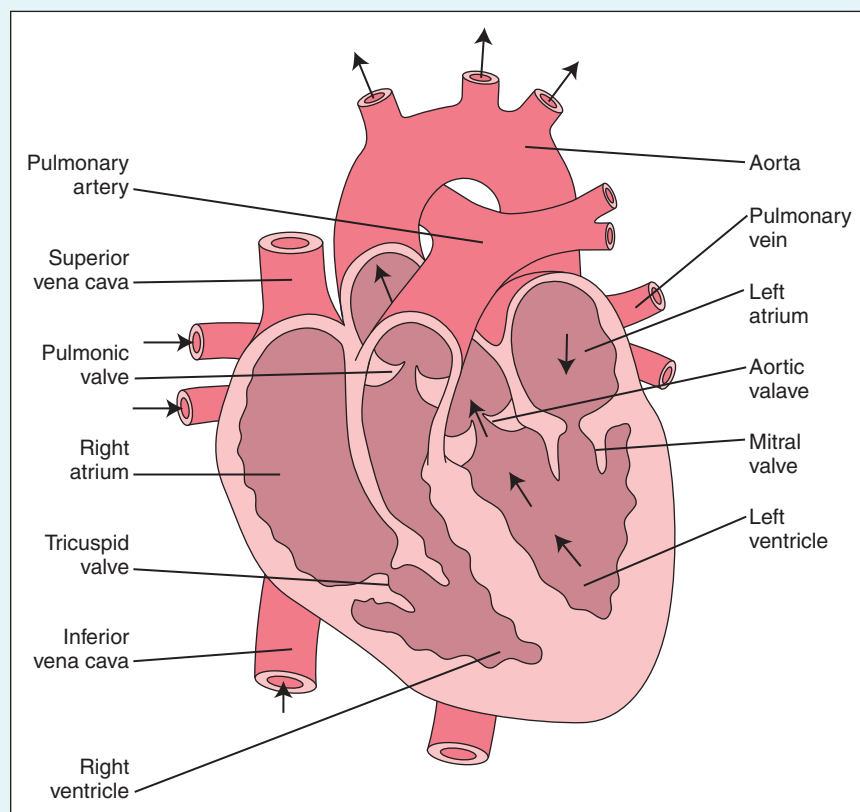


FIGURE 17–1 Heart structures and path of oxygenated blood out of the heart.

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OVERVIEW OF ANATOMY AND PHYSIOLOGY—cont'd

- The coronary arteries branch from the aorta and supply the cardiac muscle with blood.
- The left coronary artery divides into the anterior descending and the circumflex arteries providing blood for the left atrium and the left ventricle.
- The right coronary artery supplies the right atrium, right ventricle, and part of the posterior wall of the left ventricle, as well as the atrioventricular node of the cardiac conduction system (Figure 17–2).
- The heart is located within the mediastinum and is tilted forward and to the left side of the chest.
- The point of maximal impulse (PMI) can normally be felt between the fifth and sixth ribs on a line dividing the left clavicle in half. Listen to the apical heart rate at this location.

What causes the heart to contract and pump blood?

- The heart's pumping action is sparked by specialized pacemaker cells and conduction fibers that initiate spontaneous electrical activity, causing muscle contractions that result in a heartbeat.
- The conduction pathways are located in the myocardium and transmit the electrical impulse throughout the heart.
- The sinoatrial (SA) node is located in the right atrium and is called the “pacemaker” of the heart

because it normally initiates the electrical impulses.

- The atrioventricular (AV) node is located in the lower part of the right atrium. It relays the impulse from the SA node to the bundle of His and throughout the ventricles via the Purkinje fibers (Figure 17–3).
- The heart rate and rhythm also are influenced by the autonomic nervous system; factors affecting that system can speed up or slow down the heart rate.

What is the cardiac cycle?

- The cardiac cycle consists of contraction of the muscle (systole) and relaxation of the muscle (diastole).
- The heart pumps out about 5 L of blood every minute (cardiac output).
- The amount of cardiac output depends on the heart rate, the amount of blood returning to the heart (venous return), the strength of contraction, and the resistance to the ejection of the blood (pressure in the arterial system)

What is the ejection fraction?

- The ejection fraction is the percentage of blood that is ejected from the heart during systole.
- A normal ejection fraction is 50% to 70%.

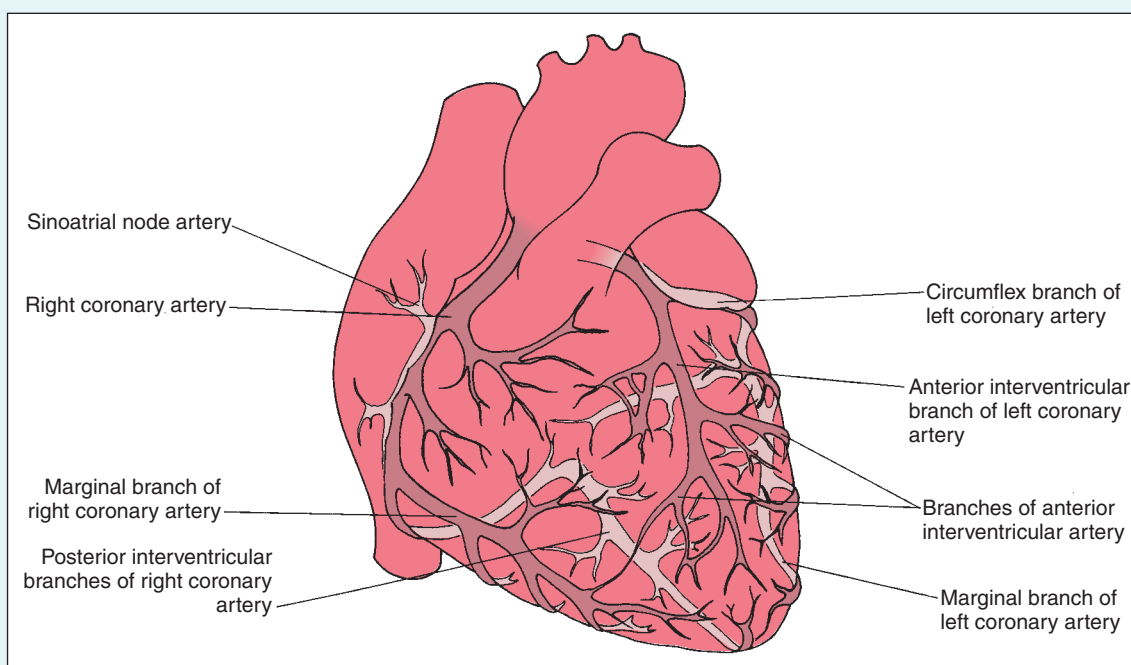


FIGURE 17–2 A view of the coronary arterial system.

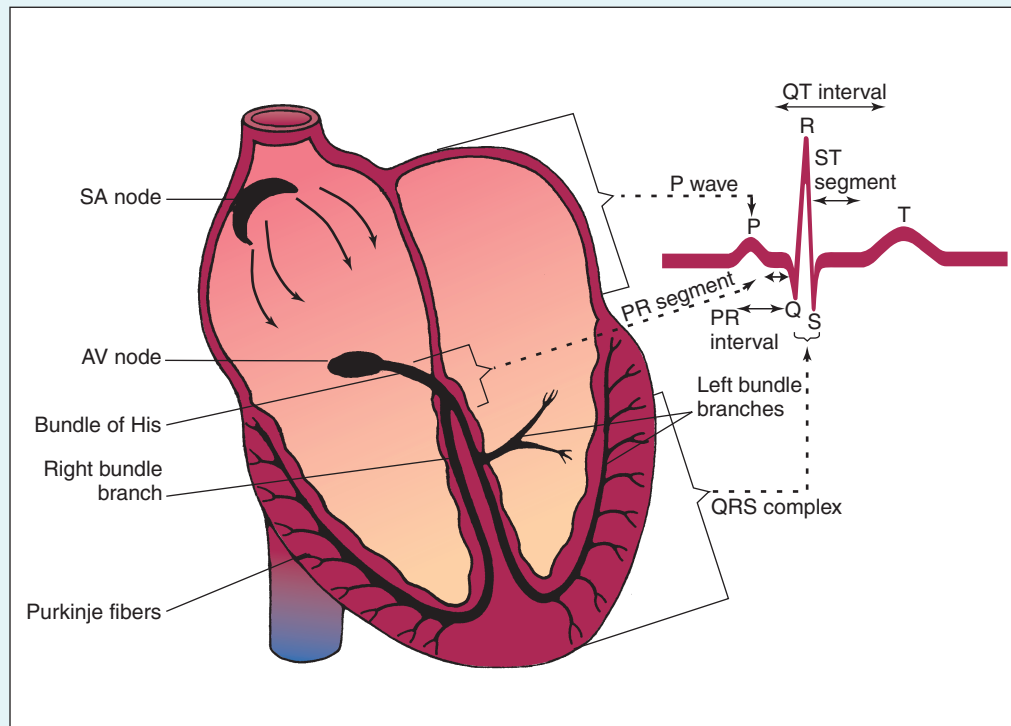


FIGURE 17-3 The cardiac conduction system.

- As ejection fraction decreases with heart failure, tissue perfusion diminishes.
- A decreased ejection fraction causes back up of blood into the pulmonary vessels.
- Too much blood and the increased pressure in the pulmonary vessels can cause pulmonary edema.
- **Stroke volume** equals the amount of blood pumped out of the heart each minute.
- **Cardiac output** equals stroke volume multiplied by the heart rate for 1 full minute.

How does the vascular system function to carry blood throughout the body?

- Three types of blood vessels make up the vascular system: arteries, veins, and capillaries; these vessels conduct the blood from the heart to the body tissues and back through the lungs to the heart.
- Arteries carry oxygenated blood away from the heart. Veins carry oxygen-depleted blood back to the heart for reoxygenation by the lungs (Figure 17-4).
- Small veins, *venules*, and small arteries, *arterioles*, are connected by the capillaries.
- The aorta is the largest artery in the body, and it receives blood from the left ventricle.
- The inferior and superior vena cava are the largest veins in the body and empty blood into the right atrium of the heart.
- Arteries are elastic and accommodate changes in blood flow by constricting or dilating.
- Three layers of tissue make up the artery wall; the outer layer, the *tunica adventitia*, is connective tissue; the middle layer, the *tunica media*, is smooth muscle; and the inner layer, the *tunica intima*, consists of endothelial cells.
- Veins have the same three layers but with less smooth muscle and connective tissue. The veins are thinner and less rigid, and for that reason the veins can hold more blood.
- The heart pumps blood through the arterial system with each contraction. Skeletal muscle contraction, respiratory movements that change pressures in the chest, and constriction of the veins propel blood back to the heart.
- Sets of valves in the medium and large veins open and close, keeping blood flowing toward the heart. Figure 17-5 shows the venous system.
- For blood to circulate the arteries must be unobstructed, and they must be able to dilate and constrict as necessary to regulate the blood flow. Veins also must be patent, their valves must func-

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OVERVIEW OF ANATOMY AND PHYSIOLOGY—cont'd

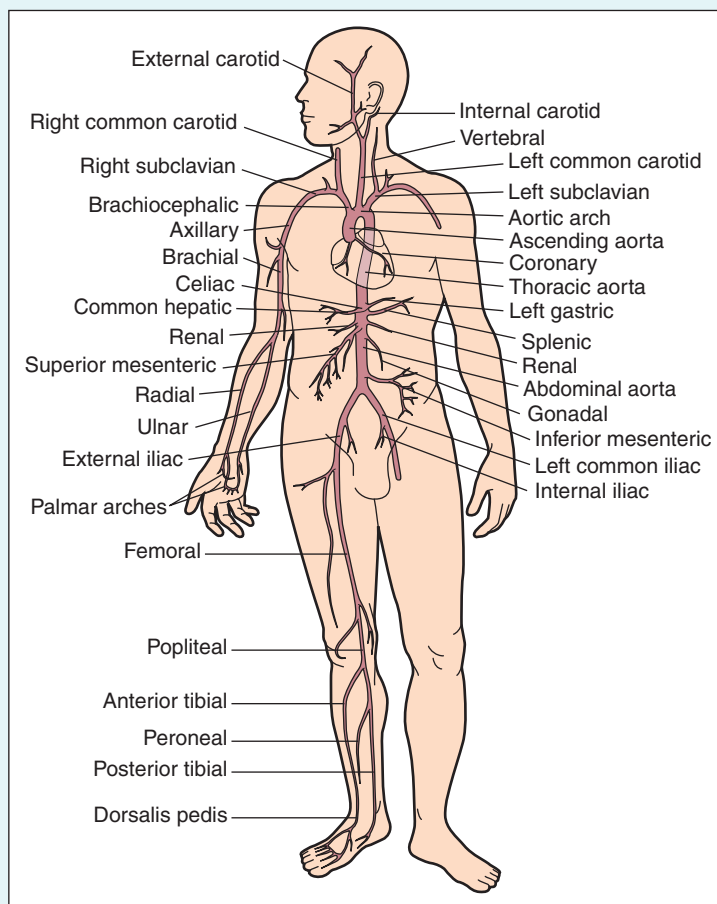


FIGURE 17-4 Major arteries in the body.

tion normally, and surrounding muscles must contract so that venous blood is continually being moved in the direction of the heart.

What is blood pressure and what affects it?

- Arterial blood pressure is the force that the blood exerts against the walls of the aorta and its branches.
- The blood pressure is greatest during ventricular contraction, *systole*, when blood is ejected into the aorta.
- Diastolic pressure is the pressure when the ventricles are in the relaxation phase, *diastole*, just before the next contraction of the ventricles.
- The difference between the systolic blood pressure and the diastolic blood pressure is called the *pulse pressure*.
- If the caliber of blood vessels becomes smaller because of **atherosclerosis**, blood pressure increases in an effort to force the blood through the smaller opening. Atherosclerosis is the condition in which fibrous plaque with fatty deposits form in the interior layers of the arteries, causing narrowing.
- If there is an increase in the volume of fluid in the blood vessels, the pressure within the vessels increases, and the heart must work harder to pump the increased volume of fluid through the vessels.
- If blood volume decreases, the kidneys secrete the enzyme renin in the blood (Figure 17-6).
- Renin acts on certain blood proteins to produce angiotensin.
- Angiotensin acts directly on the blood vessels, causing them to constrict, and stimulates the adrenal gland to release aldosterone. Angiotensin increases resistance to blood flow in the peripheral vessels and causes sodium and water retention by the renal tubules through its influence on secretion of aldosterone.

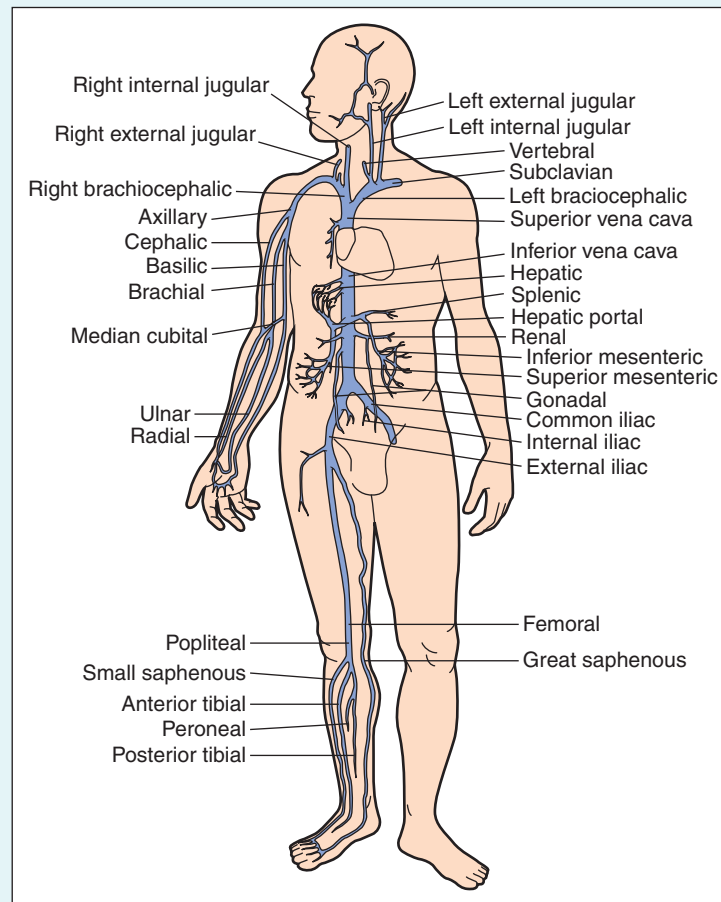


FIGURE 17-5 Major veins in the body.

- The retained sodium and water increase the blood volume, causing increased cardiac output and blood pressure elevation.
- Blood flow is affected by the amount of resistance in the vessels and by the viscosity of the blood.
- Vascular resistance is controlled by the nervous system, hormones, blood pH, and some ions that regulate the diameter of the vessels.
- **When the vessel diameter increases, resistance falls and blood flow increases. When vessel diameter decreases, resistance rises and blood flow decreases.**
- The sympathetic nervous system plays a major role in regulating vessel diameter as it prompts the release of the hormones norepinephrine and epinephrine that cause vasoconstriction.
- Blood viscosity is affected by the hydration status of the body. When dehydration occurs, blood viscosity increases; thicker blood causes an increase in blood pressure.

What changes occur in the cardiovascular system with aging?

- The aging heart becomes stiffer and contractile ability decreases, resulting in decreased stroke volume in the elderly.
- The coronary arteries become tortuous and dilated and have areas of calcification.
- The cardiac valves become thickened, particularly the mitral and aortic valves, which are subject to higher pressures. A systolic murmur is common in those older than age 80.
- The SA node loses about 40% of the pacemaker cells over time predisposing to cardiac **dysrhythmias** or SA node failure.
- The aorta becomes stiffer contributing to an increase in systolic blood pressure because the left ventricle must pump against greater resistance.
- Atherosclerosis is a natural part of the aging process, and atherotic plaque begins to occur after age 20.

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OVERVIEW OF ANATOMY AND PHYSIOLOGY—cont'd

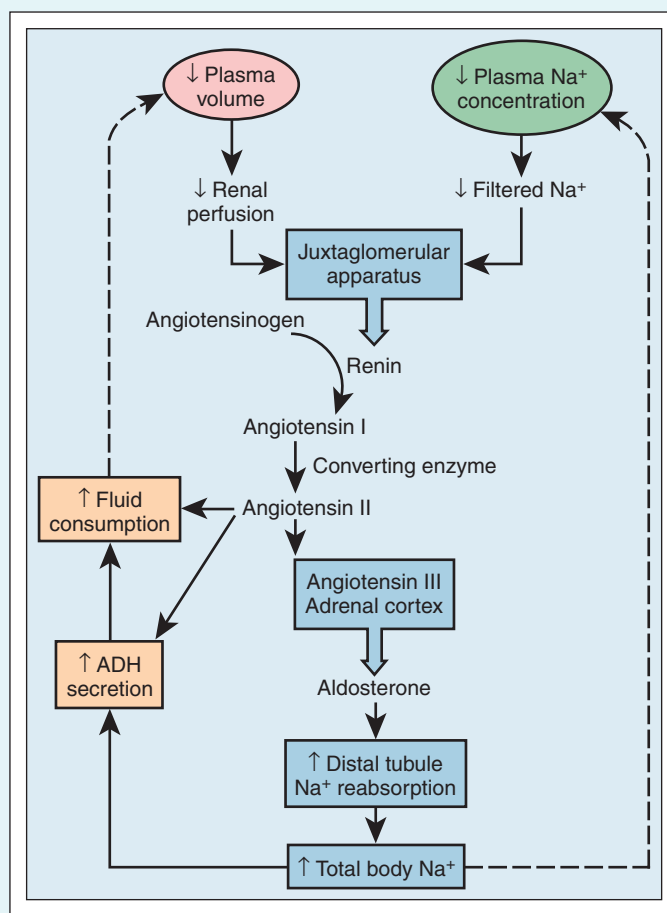


FIGURE 17-6 The renin-angiotensin-aldosterone system.

- The arterial walls thicken and lose elasticity, making them less able to adjust to changes in volume and to comply with sympathetic stimulation.
- Varicose veins develop in the elderly as veins lose their elasticity, valve function lessens, and the leg muscles weaken and atrophy from decreased exercise.
- Platelet aggregation and increased coagulation potential lead to a greater incidence of thrombus formation, deep vein thrombosis, and thrombophlebitis in those of advanced age.
- Chronic health problems and failing eye sight often lead to less activity in the elderly, predisposing to vascular problems.

branching from it. Diseases of the peripheral arteries invariably lead to **ischemia** (localized deficiency of blood) of the tissues. If the ischemia is not relieved, the ultimate outcome is tissue necrosis and gangrene.

Resistance to the flow of blood through the veins leads to increased pressure within the walls of the vessel. When blood is not moved out of the veins of the lower extremities, it accumulates there and provides a medium for the growth of bacteria and may contribute to the formation of leg ulcers.

? Think Critically About . . . Can you think of two physiologic reasons why the elderly are more at risk for hypertension?

CAUSES OF CARDIOVASCULAR DISORDERS

Causes of cardiovascular disorders can be congenital or acquired. Narrowing of the aorta (**coarctation**), holes in the septum, or abnormal formation of a cardiac valve can occur congenitally. Acquired defects include narrowing or hardening of the blood vessels from **arteriosclerosis** or atherosclerosis and aneurysms of the large vessels. Inflammation of the valve structure may cause narrowing (stenosis) or incomplete closure (insufficiency) of the valve. Alteration of the myocardial muscle tissue by extra growth with thickening (hypertrophy) or fibrosis may occur as a result of systemic **hypertension**, pulmonary hypertension, or valve problems. Lack of adequate blood supply



Health Promotion Points 17–1

Prevention of Cardiovascular Disease in Women

Public awareness among women needs to be increased concerning the following ways to prevent cardiovascular disease:

- Obtain regular physical activity—at least 30 minutes four to five times a week.*
- Maintain HDL >50 mg/dL, LDL <129, and triglyceride levels <150 mg/dL.
- Refrain from smoking
- Do not consume more than 1 alcoholic drink per day
- Obtain and maintain a healthy weight as it reduces the chance of type 2 diabetes.* Type 2 diabetes increases the risk of cardiovascular disease.
- Maintain a body mass index (BMI) of <25.
- Discontinue use of estrogen contraception/supplementation as soon as possible.
- Reduce the amount of trans fat in the diet.
- If diabetes is present, keep blood sugar <100 mg/dL.
- If hypertension is present, take medication regularly to keep pressure within 130/80 (<115/75 is optimal).
- Incorporate stress reduction techniques into the daily lifestyle, as increased stress is a risk factor for cardiovascular disease.

*These factors play an even larger role in prevention of heart disease in women than in men.

(ischemia), or **infarct** (area of tissue that has died from lack of blood supply) may occur from coronary artery stenosis. Deterioration of the pacemaker cells and conduction fibers related to hypertrophy or inflammation of tissues may cause conduction disorders.

Several disorders involving either the heart or the vessels through which it pumps blood can eventually weaken and damage the heart muscle and lead to pump failure. This condition, called *heart failure*, is a complication of many cardiovascular diseases, as discussed in the following chapters.

Disturbances in any part of the heart's conduction system can result in an increase in heart rate (tachycardia), a slowing down of the heart rate (bradycardia), and disturbances in the rhythm of the heart beat (dysrhythmias).

Infection and inflammation also can take their toll on the structure and function of the heart. **Endocarditis**, inflammation within the lining and valves of the heart, and **pericarditis**, an inflammation of the sac surrounding the heart, can occur as primary diseases, but they are more often secondary to infection and inflammation elsewhere in the body. An example is rheumatic heart disease, which occurs after a streptococcal infection.

Substances in the blood, such as excess carbon dioxide and certain drugs, can affect the rate and rhythm of the heart through their effect on the auto-

nomic nervous system. The heart also responds to physiologic changes that indicate a need for more or less oxygen.

The arterial walls can be injured by several factors. Hypertension (persistently elevated blood pressure) causes a mechanical injury by applying increased pressure continuously on the arterial walls. For each increment of 20/10 mm Hg above a pressure of 115/75, the risk of CVD doubles (National Heart, Lung, and Blood Institute, 2003). Elevated levels of low-density lipoproteins (LDL) and decreased levels of high-density lipoproteins (HDL) predispose to the deposition of fatty deposits in the arterial walls, causing a narrowing of the vessels. Chemical toxins, such as carbon monoxide, present in the blood when a person smokes, and the toxins caused by renal failure, cause injury to the arterial walls. Physiologic disorders, such as diabetes mellitus, directly cause physical changes in the vessel walls, leading to more rapid arteriosclerosis (loss of elasticity), possibly from elevated blood glucose levels, an increased rate of atherosclerosis, and an earlier onset of hypertension. Some inherited disorders, such as hyperlipidemia, contribute to atherosclerosis.

Obesity, a sedentary lifestyle, and stress are all directly related to the increased incidence of atherosclerosis and hypertension. Smoking, and the changes it causes in the vessel walls, is directly related to arteriosclerosis of the peripheral vessels and decreased circulation in the lower extremities. Long-term hypertension causes arteriosclerosis and is a direct factor in the development of aortic aneurysm in many patients. Essential hypertension cannot be prevented, but it can be managed with diligent therapy and cooperation of the patient. Through the efforts of the American Heart Association and the National Heart, Lung, and Blood Institute, the American public is becoming more aware of the risk factors of hypertension and the need to develop more sensible and wholesome habits of daily living.

PREVENTION OF CARDIOVASCULAR DISEASE

Cardiovascular diseases claimed 871,500 lives in 2004 in the United States. Heart disease remains the major cause of death in the United States. Cardiovascular diseases also account for a large percentage of the chronic illnesses that disable, to some degree, a large portion of the U.S. population.

Although the numbers for death and illness from cardiovascular diseases are high, it should be remembered that not all heart problems are either fatal or totally disabling. There are many kinds and degrees of heart disease. Advances in medical science have made it possible either to cure or successfully manage a large number of cardiovascular problems. Reasons for the decline in deaths from heart disease since the mid-1980s include improved emergency treatment of persons experiencing a coronary occlusion or "heart at-

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Health Promotion Points 17-2

Know the Signs of a Heart Attack

All patients, family, and friends should be taught the warning signs of a heart attack:

- **Chest discomfort:** a feeling of tightness, pressure, or a crushing or squeezing pain lasting more than a few minutes, or it comes back.
- **Pain or discomfort in other areas of the upper body:** arms, shoulder, back, neck, jaw, or the top of the stomach.

- **Shortness of breath:** may occur with or without chest discomfort.
- **Breaking out in a cold sweat,** nausea or lightheadedness with or without chest discomfort.
- **Feeling of impending doom** that doesn't go away.
- **Chest pain** unrelieved by prescribed doses of nitroglycerin.

Call 911 or emergency number immediately—get help!

Table 17-1 Risk Factors for Cardiovascular Disease

UNMODIFIABLE RISK FACTORS	SIGNIFICANCE
Heredity	Children of parents with cardiovascular disease are more likely to develop the same problem.
Race	African Americans experience high blood pressure two to three times more frequently than whites. Consequently the risk of heart disease in this group is higher.
Sex	Males experience more heart attacks than females earlier in life. After age 65, the death rate from heart disease increases in women.
Age	Four out of five people who die of a heart attack are age 65 or older. Increasing age increases risk.
MODIFIABLE RISK FACTORS	MEANS OF MODIFICATION
Obesity	Keep weight within normal limits by diet and exercise.
High cholesterol >200 mg/dL	Low-fat diet and exercise; medication.
Hypertension	Encourage blood pressure <120/80.
Diabetes	Good control by keeping blood sugar within normal limits (<100 mg/dL).
Cigarette smoking	Quit smoking
Sedentary Lifestyle	Exercise program of 30-min sessions 3 to 5 times a week.
Excessive stress	Use stress-reduction techniques regularly, such as exercise, relaxation techniques; reduce hostility; maintain a positive support system.
Excessive alcohol intake	Limit alcohol consumption to no more than recommended levels: Men—2 drinks/day; Women—1 drink/day.
Cocaine use	Do not use cocaine.

tack,” improved education of the public regarding ways to prevent heart disease, and teaching about the warning signs of a heart attack. Every nurse has a responsibility to assist with public education about heart disease (Health Promotion Points 17-2).

Table 17-1 presents the risk factors for heart disease. Metabolic syndrome is particularly an indicator of cardiovascular risk (Apoor, 2007). It is diagnosed when three or more of the components in Box 17-1 are present. Modifiable risk factors are the major focus for education to prevent heart disease. Old habits are hard to change, but there is strong evidence that reducing these risk factors can greatly cut down the chance of developing heart disease and thereby improve the quality of an individual's life.

The use of cocaine and methamphetamine has added to the problem of heart disease (National Institute on Drug Abuse, 2007). Cocaine causes vasoconstriction and is thought to speed up the atherosclerosis process. Also, cocaine has been known to cause sudden cardiac death, or stroke, in susceptible individuals. Research is finding that the ingestion of both alcohol and cocaine greatly increases the chance of cardiac death. Methamphetamine increases heart rate, causes vasoconstriction that can lead to hypertension, and

Box 17-1 Metabolic Syndrome Components

When three or more of the following are present, the patient is diagnosed with metabolic syndrome. People with metabolic syndrome are at increased risk of cardiovascular disease. Approximately 50 million Americans have it.

- Elevated waist circumference indicating abdominal obesity; men >40 inches (102 cm), women >35 inches (88 cm)
- Elevated triglycerides >150 mg/dL
- Reduced HDL cholesterol; men <40 mg/dL and women <50 mg/dL
- Elevated blood pressure at or above 130/85 mm Hg
- Elevated fasting glucose indicating insulin resistance; glucose \geq 100 mg/dL

speeds up electrical conduction, potentially causing dysrhythmias and myocardial infarction (MI). Cigarette smoking-related health problems are heavy contributors to heart disease, and smoking is a key factor in sudden cardiac death.

Uncontrollable risk factors cannot be prevented by an individual. However, control of diseases such as hypertension and diabetes mellitus, and the reduction of

high cholesterol, which are factors in the development of atherosclerosis, are possible and can help prevent the early onset of heart disease. It has been proven that, if a diabetic can keep the blood sugar consistently below 110 mg/dL, the risk of atherosclerosis is lessened (Shichiri, 2001). Management of hypertension is one of the major tools for heart disease prevention.

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? *Think Critically About . . .* Can you identify two risk factors you can modify to decrease your risk of heart disease?

A major component in the prevention and control of high blood pressure is education. Nurses can play an important role in teaching others about the disease and supporting their efforts to avoid hypertension and its long-term consequences.

Although systolic blood pressure rises as a natural process of aging because arteries become less elastic, systolic hypertension should be treated in the elderly patient. Hypertension in the elderly is associated with an even higher risk of heart disease, stroke, and death from coronary thrombosis (Wenyu, 2007). Hypertension has been associated with more rapid memory loss and loss of cognitive function in some research studies.

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You can contribute to reducing the incidence of the harmful effects of hypertension by participating in community screening programs to detect hypertension in its early stages, confirm its presence, and initiate prompt treatment. In addition, nurses and other health care professionals have an obligation to serve as models for a healthy lifestyle.

DIAGNOSTIC TESTS AND PROCEDURES

In addition to a routine physical examination and medical history, the physician has access to a number of both noninvasive and invasive procedures and tests to help diagnose cardiovascular disease. Because of the hazards and risks of invasive procedures that require entry into the cardiovascular system or the injection of substances into the circulating blood, noninvasive procedures usually are performed first. A chest x-ray is ordered to visualize the size of the heart.

Nuclear imaging often is combined with an exercise ECG—the stress test. Echocardiography also can be done from inside the esophagus using an esophagogastroscope and special transducer. Digital subtraction angiography (DSA) is a form of computer-enhanced angiography that provides a clearer picture of the coronary arteries and their patency. Magnetic resonance arteriography is a new test that may some day replace angiography. Specific cardiovascular diagnostic tests and their nursing implications are listed in Table 17–2. In women, a thallium exercise stress test or electron-beam computed tomography for coronary ar-

tery calcium scoring may be better than the standard treadmill test for detecting heart disease. A stress echocardiogram also is helpful (Figure 17–7).

TELEMETRY

Continuous monitoring of cardiac rate and rhythm often is done by telemetry. Disposable electrodes and wire leads from a bedside monitor or battery-operated transmitter unit are applied to the patient. The wave pattern signals are sent to a monitor in a central station, where they are continually observed (Figure 17–8). This allows patients to walk around the nursing unit while being monitored. The wave may also be displayed on a bedside **oscilloscope**. An oscilloscope is a machine that shows a picture of electrical current and its variations. In this instance, the patient's movement is limited by the wire attachments. Modern computerized telemetry monitors can detect specific dysrhythmias (abnormal variations of heart rhythm), automatically store the wave pattern, and alert the nurse to the abnormality with an alarm. Telemetry monitoring is used for patients experiencing an acute cardiac disorder, after cardiac surgery, and after pacemaker insertion. Figure 17–9 shows proper placement for telemetry leads.

SPECIFIC TESTS FOR VASCULAR DISORDERS

Diagnosing a vascular problem begins with a history and physical examination that includes a variety of tests for risk factors for vascular disorders. A complete blood (CBC) count, urinalysis, blood lipid and cholesterol assessment, including high-density lipid (HDL) and low-density lipid (LDL), or sequential multiple analyzer (SMA) panel that screens liver and kidney function, electrolytes, and blood glucose are ordered. If blood pressure is elevated, tests of thyroid, adrenal glands, kidneys, and renal arteries are done to rule out the possibility of another disease that might cause secondary hypertension. Hyperthyroidism, Cushing syndrome, pheochromocytoma, nephrosclerosis, and renal arterial stenosis all elevate blood pressure.

Doppler flow studies are performed to detect a thrombus when one is suspected and to assess the patency of the carotid arteries. Angiography may be performed to determine areas of narrowing in arteries or to detect a lodged embolus. Nuclear medicine scans are performed to detect emboli in the lungs.

The *retrograde filling test* is performed to assess the competency of the valves in the saphenous and communicating veins of the legs. Position the patient supine and raise his or her leg to 90 degrees to drain the venous blood. Place a tourniquet around the upper thigh to occlude the vessels. If the vein does not fill from below within 35 seconds, the valves are not functioning correctly. Release the tourniquet and observe vein filling. Normal valves slow the filling process; if valves are incompetent, filling occurs immediately.

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Table 17-2 Common Diagnostic Tests for the Vascular System

TEST	PURPOSE	PROCEDURE	NURSING IMPLICATIONS
Electrocardiography 12-Lead electrocardiogram	Records electrical impulses of the heart to determine rate, rhythm of heart, site of pacemaker, and presence of injury at rest.	Small electrodes are placed on the chest and extremities, to show conduction patterns in different directions of electrical flow. Figure 17-3 shows a basic ECG tracing.	Inform patient that there is no discomfort with this test. Maintain electrical safety. Normal finding: normal ECG.
Exercise ECG stress test	Records electrical activity of the heart during exercise. Insufficient blood flow and oxygen show up in abnormal wave forms.	Small electrodes are placed on the chest, and a tracing is made while the patient exercises on a treadmill, bicycle, or stairs. The degree of difficulty of the exercise is increased as the test continues to see how the heart reacts to increasing work demands. Vital signs are continuously recorded. May be combined with radionuclide imaging or echocardiograph. Physician is present.	Requires a signed consent form. Have patient wear comfortable clothes and walking shoes. Light meal 2–3 hr prior, then NPO Regular medications are given. Chest is shaved as needed for electrode placement. Inform patient that the test will be stopped if chest pain, severe fatigue, or dyspnea develop.
Ambulatory ECG: Holter monitor	Correlate normal daily activity with electrical function of the heart to determine whether activity causes abnormalities.	Patient wears a small ECG recorder for 6, 12, or 24 hr while going about usual tasks. A diary is kept to show at what time the various activities were performed and any symptoms experienced. The tape is analyzed to correlate any dysrhythmia with the activity at that time.	Remind patient that all activities must be recorded in the diary: brushing teeth, climbing stairs, sexual intercourse, bowel movements, sleeping, etc. Caution patient not to remove the electrodes and not to get the recorder or wires wet. Have patient wear a loose shirt during test.
Echocardiography	Useful in evaluating size, shape, and position of structures and movement within the heart. Test of choice for valve problems.	A metal wand that emits sonar waves is guided over the chest wall while the patient is supine or turned on the left side. Takes 30–60 min. May be done in combination with the exercise (stress) test. Transesophageal echocardiography may be performed with a gastroscope to position the wand.	Inform patient that there is no discomfort, although conduction jelly may feel cool. Inform patient that there is no discomfort, although conduction jelly may feel cool. Normal finding: No abnormalities of size or location of heart structures; normal wall movement. Used for very obese patients or those with a barrel chest. Positioning the gastroscope requires sedation.
Stress echocardiogram	Detect differences in left ventricular wall motion before and after exercise.	Resting echocardiogram images are obtained. The patient exercises, and then within 1 min, postexercise images are obtained.	Explain the procedure and the importance of returning to the examining table immediately after exercising. No heavy meal beforehand, no smoking or caffeine for 6–8 hr before test. Tell patient to wear walking shoes.
Dobutamine echocardiogram	A substitute for an exercise stress test when individual cannot exercise. Detects abnormal heart wall motion.	IV dobutamine, a positive inotropic agent, is infused. The dosage is increased at 5-min intervals during the echocardiogram.	Administer IV dobutamine as ordered. Monitor vital signs; watch for symptoms of distress.

Key: MAP, mean arterial pressure; PAWP, pulmonary artery wedge pressure; PADP, Pulmonary artery diastolic pressure; RAP, right atrial pressure.

Table 17-2 *Common Diagnostic Tests for the Vascular System—cont'd*

TEST	PURPOSE	PROCEDURE	NURSING IMPLICATIONS
Cardiac catheterization	Assesses pumping action of both sides of the heart. measures pressure within the heart chambers. Measures cardiac output. Calculates differences in oxygen content of arterial and venous blood.	Requires a signed consent form, as it is not without risk. Catheter is inserted into vein or artery, depending on which side of the heart is to be tested. Femoral artery or brachial vein is often used. With local anesthetic, the catheter is threaded up into the heart, and pressure readings and oxygen saturation determinations are taken. Contrast media may be injected to visualize the size and shape of the chambers and structures. Takes 1½–3 hr. Fluoroscopy is used during the procedure.	Patient is NPO for 6–8 hr prior to test. Assess for allergy to iodine, shellfish, or contrast dye. Have patient void before giving preop medication. Record baseline vital signs and mark location of pedal pulses. Inform patient that procedure involves being strapped to a table that tilts, will have an IV, and patient must lie still during test. ECG leads will be in place during the test. If dye is used, patient will feel a hot flush for a minute after the dye is injected. Patient may be asked to cough during the procedure. He will be constantly monitored and emergency equipment is at hand. Posttest: vital signs q 15 min × 4, q 30 min × 4, then q 1 hr × 4, or until stable. Assess peripheral pulses with vital signs and question patient about numbness or tingling. Inspect insertion site for bleeding or sign of hematoma. Pressure dressing and sandbag weight are left in place for 1–3 hr. If femoral insertion site was used, keep patient flat and leg extended for 6 hr. If brachial site was used, immobilize arm for 3 hr. If dye was used, encourage fluids unless contraindicated. Mark location of distal pulses before the procedure. Post-procedure, prevent hip flexion on affected side. Same as for cardiac catheterization.
Coronary angiography	Determines patency of coronary arteries and presence of collateral circulation.	Performed by dye injection during cardiac catheterizations. Video recording made during procedure for later review.	
Intravascular ultrasound	Provide visual information about the interior of a coronary artery.	A flexible catheter with a miniature transducer at the tip is introduced into a peripheral vessel and advanced into a coronary artery. The transducer emits high-frequency sound waves, which create a 2- or 3-dimensional image of the vessel lumen.	Consent form required. See cardiac catheterization for posttest care.

Continued

Table 17-2 Common Diagnostic Tests for the Vascular System—cont'd

TEST	PURPOSE	PROCEDURE	NURSING IMPLICATIONS
Electrophysiology studies	Measures and records electrical activity from within the heart to determine the area of origin of the dysrhythmia and the effectiveness of the antidysrhythmic drug for the particular dysrhythmia.	Three to six electrodes are placed in the heart through the venous system. They are attached to an oscilloscope that records the intracardiac and ECG waveforms simultaneously. After baseline tracings are taken, the cardiologist tries to trigger the dysrhythmia that is to be studied by programmed electrical stimulation through the electrodes. Once the dysrhythmia is triggered, an antidysrhythmic drug is administered to determine its effectiveness in stopping the abnormal rhythm. Studies may take from 1½–4 hours; serial studies may be done on different days.	Provide psychologic support for the patient, who is often scared of having dysrhythmias induced. Antidysrhythmic drugs may be stopped 24 hr or more before the test to eliminate them from the patient's system. Assure the patient of constant monitoring and that emergency equipment and staff will be on hand. Keep patient NPO after midnight. Patent IV line is maintained. Electrodes are placed using fluoroscopy. Patient will be supine on an x-ray table. Chest surface electrodes will be placed before the electrodes are threaded into the heart. The femoral vein is most commonly used; the groin is shaved, and local anesthesia is used. Posttest care: much the same as for cardiac catheterization.
Nuclear imaging (thallium perfusion imaging)	Evaluates blood flow in various parts of the heart; determines areas of infarction.	Thallium-201 is injected IV, radioactive uptake is counted over the heart by a gamma scintillation camera. May be done in conjunction with an exercise ECG stress test.	Explain that the radioactivity used is a very small amount and lasts only a few hours. Explain that a camera will be positioned over the heart. ECG electrodes are placed on the chest; scanning is done 10–15 min after injection; can be done as an outpatient procedure. May be done in two parts a few hours apart.
Dipyridamole (Persantine) stress test	Used for those who cannot exercise for an ECG stress test.	An ECG is done, and IV dipyridamole (Persantine) is given. Blood pressure and pulse are taken and recorded q 15 min while the drug takes effect by diverting blood flow from the coronary arteries, causing cardiac ischemia. Thallium is injected, and scanning images are taken over a period of about 40 min. Repeat scan is done several hours later. The patient is NPO during the test.	Mild nausea or headache may occur. Explain that patient will lie on back for the imaging. If BP drops too low, neosynephrine is given.
Ultrasound Doppler flow studies	Detect clot in vessel; determine degree of narrowing of vessel or detect arterial spasm. Most commonly performed on the lower extremities and the carotid vessels.	A gel is applied to the skin. An ultrasound wand is moved over the skin above the vessel; the skin should be clean and dry with no lotions or powders.	Explain that the test takes about 30 minutes.
Venogram	To detect thrombosis or narrowing of a vein	Requires a consent form as radiopaque substance is injected into the vessel and radiographs are taken.	Explain that the procedure is somewhat uncomfortable as the dye can be irritating to the vessels, causing a burning sensation.
Venous imaging B/mode	Ultrasound detection of deep vein thrombosis. B/mode shows a two-dimensional image.	Uses real-time duplex scanning. Patient is placed supine in reverse Trendelenburg position; the vessels are scanned. Then patient is placed prone for further vessel examination.	Explain positioning necessary and that the scan head will be moved down the leg to scan each venous segment.

Table 17-2 *Common Diagnostic Tests for the Vascular System—cont'd*

TEST	PURPOSE	PROCEDURE	NURSING IMPLICATIONS
Angiogram (arteriogram)	Determine areas of narrowing or structural changes, such as an aneurysm in an artery. Detect the presence of an embolus. Most frequently performed on vessels in the heart, lungs, or head.	Requires a consent form. A catheter is threaded into an artery and a radiopaque dye is injected. Radiographs are taken. Preoperative preparation is necessary. Postoperative care includes careful monitoring for bleeding from the catheter insertion site, and neurologic signs and vital signs are taken frequently to monitor for the possibility of embolus or bleeding. Sensation distal to the catheter insertion site also is checked, as internal bleeding can cause a hematoma that presses on nerves.	Preparation is similar to that for surgery. Explain that preoperative medication will be given. Increase fluids if a contrast medium was used to flush the dye through the kidneys. Consent form required.
Impedance plethysmography	Estimates blood flow in a limb based on electrical resistance present before and after inflating a pneumatic cuff placed around the limb. Used to detect deep vein thrombosis.	Measurements of electrical resistance are taken before and after a pneumatic cuff placed around the limb is inflated. Electrodes are placed on opposite sides of the limb.	Instruct to wear loose clothing. Explain that some discomfort may occur during inflation of the cuff. The patient is placed on an examination table and positioned supine in a relaxed comfortable position. The limb is properly positioned, and electrodes and the pneumatic cuff are applied.
Nuclear medicine scan	Detect blood clots, particularly pulmonary emboli.	A radioisotope is injected, and after a waiting period for uptake, a scintillation scanning camera is used to measure the amount of radioactivity present in the area in question.	Determine whether patient has an allergy to the dye. Posttest encourage large fluid intake to flush the dye through the kidneys.
CT scan	Determine size and condition of aortic aneurysm.	Noninvasive, unless dye contrast used. Patient is positioned on scanning table and moved under the scanner.	Instruct in necessity of holding still during scan.
Carotid duplex examination	Study blood flow in external carotid arteries.	Patient is positioned supine with neck extended. The probe is moved up and down each side of the neck over the external carotid arteries.	Explain that plaque in the arteries can be visualized in this manner. This test assists in determining need for endarterectomy surgery.
Technetium pyrophosphate scan and multiple-gated acquisition (MUGA) scan	Determine area and extent of myocardial infarction. Assess left ventricular function.	Technetium-99m (^{99m} Tc) is injected IV and is taken up by areas of infarction, producing hot spots when scanned. Multiple serial images are obtained. Best results occur when done 1–6 days after a suspected MI.	Inform patient that scan is done 1½ to 2 hr after injection of the ^{99m} Tc. Explain that the test will determine whether any damage occurred from an MI.
Positron emission tomography	Evaluate myocardial perfusion.	IV nitrogen-13-ammonia is injected and a scan performed to show myocardial metabolic function. Then fluoro-18-deoxyglucose is injected and a scan performed. In a normal heart, the scans will match; in an ischemic heart, the scans will differ.	Explain that radioisotopes will be given IV. It will be necessary to lie still while the machine scans the heart. The patient's glucose must be between 60–140 mg/dL. If scan is combined with exercise, patient will need to be NPO and must refrain from tobacco and caffeine for 24 hr before the test.
Magnetic resonance imaging (MRI) Magnetic resonance arteriography (MRA)	Evaluate cardiac tissue integrity, detect aneurysms, determine ejection fraction and cardiac output, and determine patency of proximal coronary arteries.	Noninvasive magnetic resonance is used to depict tissue images. IV gadolinium is injected as a contrast medium for the MRA.	Explain about the cylinder within which the patient will be positioned. Warn that there will be loud noises from the machine. Administer antianxiety medication if needed and ordered; provide music if patient desires it.

Continued

Table 17-2 Common Diagnostic Tests for the Vascular System—cont'd

TEST	PURPOSE	PROCEDURE	NURSING IMPLICATIONS
Electron-beam computed tomography (EBCT)	Assist in predicting whether a patient will develop heart or arterial disease.	Noninvasive 10-min scan is performed to detect calcification within the vessels that indicates plaque.	Helpful for patients with high blood pressure and/or elevated cholesterol to determine cardiovascular event risk.
Hemodynamic monitoring via Swan-Ganz catheter	Determine pressure, flow and oxygenation within the cardiovascular system. Normal: <i>Preload:</i> RAP* 2–8 mm Hg PAWP* 6–12 mm Hg PADP 4–12 mm Hg <i>Afterload:</i> MAP* 70–105 mm Hg <i>Oxygenation:</i> Arterial Hgb O ₂ saturation 95%–99% Mixed venous Hgb O ₂ Saturation 69%–80%	A special catheter, infusion system, and a transducer, and a monitor are prepared and the catheter is placed by the physician in the heart or great vessels.	The system must be calibrated to perform properly. Readings are taken for right atrial, pulmonary artery, and pulmonary wedge pressures. Other data can then be calculated regarding stroke volume, cardiac output, and oxygenation.
Laboratory tests Cardiac serum enzymes	Measures specific enzyme levels to determine what type of cells have been injured and to what extent.	Creatine kinase (CK) is found in the heart, skeletal muscle, and brain cells. It rises within 6 hr of MI and returns to normal within 48–72 hr. CK-MB is a fraction of the enzyme, or isoenzyme, that is specific to heart muscle cells. Lactic dehydrogenase (LDH) rises following MI but is not specific. LDH ₁ and LDH ₂ are the isoenzymes contained in heart muscle. If LDH ₁ /LDH ₂ >1, it indicates MI has occurred. Aspartate aminotransferase (AST) rises 6–8 hr after MI, peaks within 24–48 hr, and returns to normal in 4–8 days but is not specific to heart damage. Cardiac enzymes are usually tested q 8 hr × 3.	Explain purpose of laboratory work. Inform patient that blood will be drawn at intervals to check the rise and fall of enzyme levels.
CK	Normal values: Female: 5–35 mU/mL Male: 5–50 mU/mL		
CK-MB	<5% total CK		
LDH	15–450 U/mL		
LDH1	17%–27%		
LDH2	27%–37%		
AST	5–40 U/mL		
Serum protein troponin T	Quick test for acute MI	Done by enzyme-lined immunosorbent assay. Provides results in 2 hr. Is very accurate from 10–120 hr after onset of MI symptoms.	Quicker and more accurate than other cardiac enzyme blood tests.
Serum lipids	Determines level	Elevation of cholesterol is a risk factor for atherosclerotic heart disease.	Patient is NPO except for noncaloric liquids for 12 hr.
Cholesterol	Normal values: 150–200 mg/dL		
HDL	32–75 mg/dL		
LDL	73–200 mg/dL		

Table 17-2 Common Diagnostic Tests for the Vascular System—cont'd

TEST	PURPOSE	PROCEDURE	NURSING IMPLICATIONS
Laboratory tests— cont'd	Normal values—cont'd		
Triglycerides	50–250 mg/dL	Triglycerides contribute to arterial disease. As triglycerides rise, so do low-density lipoproteins, which are a factor in atherosclerosis. The lipoproteins (LDL, VLDL, and HDL) are increased in hyperlipidemia. Lipoprotein fractions are determined by electrophoresis and are used to assign a “risk” factor in cardiovascular disease. High levels for HDL appear to protect against coronary artery disease and MI, whereas increased levels of LDL are associated with increased atherosclerosis and MI.	
Myoglobin	To detect damage to the myocardium from a myocardial infarction. Normal range: <90 mcg/L	Requires a blood draw of 5 mL in a red-top tube. Apply pressure to venipuncture site.	Explain procedure. No fasting is required.



FIGURE 17-7 Cardiac treadmill stress test.

The ankle-brachial index (ABI) test evaluates circulatory status in the lower extremities. A regular blood pressure cuff is placed above the malleolus. Another blood pressure cuff is positioned over the brachial artery. A Doppler probe is used to check the systolic end point at the dorsalis pedis and the posterior tibial sites. The brachial blood pressure is measured. The ABI is calculated by dividing the ankle pressure by the brachial pressure. An ABI of 1 or more is considered normal. An abnormal ABI indicates arterial disease and can confirm a vascular cause for ischemic pain at rest and **claudication** (cramping pain in the calves). Table 17-2 presents the diagnostic tests used to detect other problems in the vascular system. Serum cholesterol and lipids are discussed more fully in Chapter 18.

? Think Critically About . . . Can you identify four teaching points to be covered for the patient who is to undergo an arteriogram?

NURSING MANAGEMENT

Assessment (Data Collection)

History

It is important to determine whether there are risk factors for cardiovascular disease. Important data include any family history of heart disease, diabetes mellitus, high blood pressure, hyperlipidemia, stroke, gout, or kidney disease. It is helpful, too, to know about the patient's lifestyle, such as smoking, drinking, drug use, and eating habits; weight gains or losses; type and amount of daily exercise; occupation; and sources of stress.

Much of this information is obtained by the physician or nurse practitioner during history-taking and by the admitting nurse during a complete nursing assessment. Some additional information, however, will be gathered in less formal interactions when the patient becomes more relaxed and comfortable with the nurses who care for her.

Information concerning the patient's actual eating habits, such as snacking on “junk” food or daily consumption of several drinks containing caffeine, is more likely to be obtained during nursing care activities than during the initial assessment. Data concerning stressors in the patient's life and her response to them are more easily assessed while interacting over time.

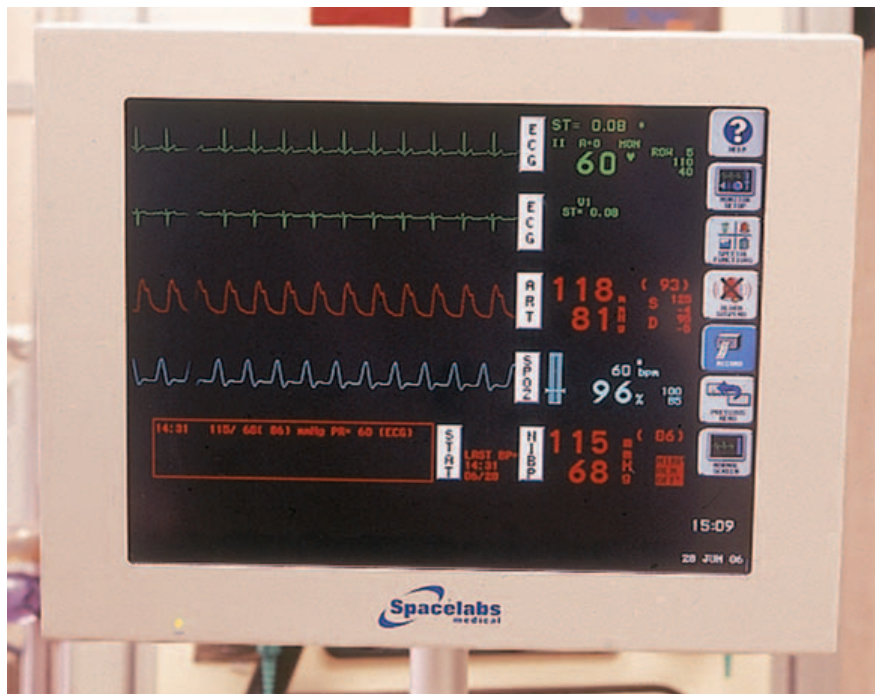
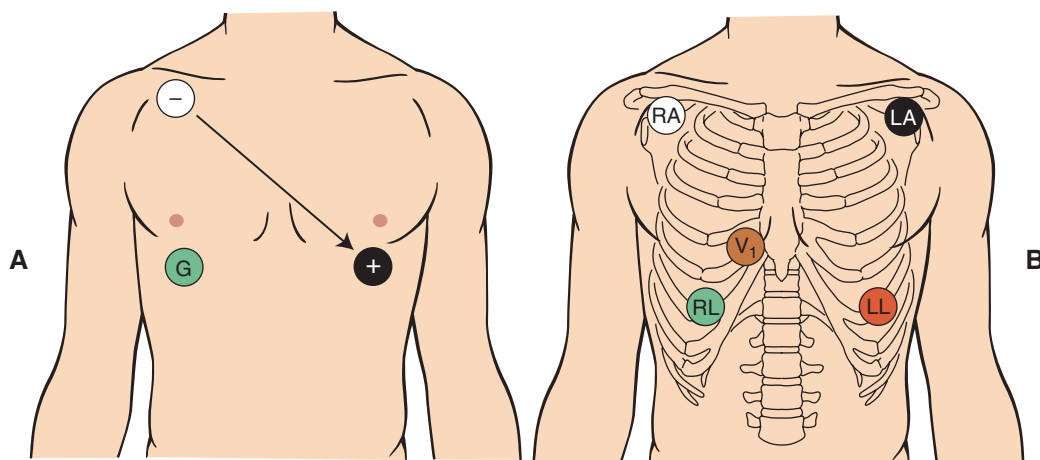


FIGURE 17-8 Telemetry monitor in an intensive care unit.



Three electrode placement

Five electrode placement

FIGURE 17-9 Placement of the most commonly used telemetry leads. **A**, Lead 2 (3-electrode system); **B**, 5 Lead (5-electrode system).

An understanding of the patient's perception of her disorder and overall health are necessary to plan appropriate teaching for her. The effectiveness of your communication with the patient will determine the quality of subjective data obtained. A history-taking guide is in Focused Assessment 17-1.

Other subjective data include questions regarding medications taken regularly, both prescription and nonprescription, as many drugs can cause vasoconstriction and elevate blood pressure. Cold remedies, decongestants, and diet pills are particularly noted for having this effect. Other prescription medications that may affect the heart are bronchodilators, anticoagulants, contraceptives, psychotropic medications, and street drugs. A careful, specific diet history should be

gathered. Fast-food intake is significant because it is often high in fat and sodium. **Excessive alcohol intake is a factor in the development of hypertension and cardiomyopathy.** Questions are asked that relate to changes from damage to the cardiovascular system, such as (CHF) heart failure, angina, or kidney failure. **Intermittent claudication**, cramping pain in the muscles brought on by exercise and relieved by rest, is a common symptom of arterial insufficiency to the lower extremities. This pain most frequently occurs in the calves of the legs, but it also can affect the muscles of the thighs and buttocks. Often chronic occlusive arterial disease will cause pain described as burning and tingling, with numbness of the toes. It is most noticeable at night when the patient is in bed.



Focused Assessment 17-1

Data Collection for the Cardiovascular System

HISTORY TAKING

When interviewing the patient who has a probable cardiovascular problem, ask the following questions:

- Do you ever have any chest discomfort or pain? What does it feel like? What, if anything, seems to bring it on? What makes it worse? How long does it last? Is it worse when you breathe in deeply? What gives relief? Does the pain radiate (spread) to other parts of the body, for example, down the arm or up into the neck or jaw, or to the upper abdomen? Is it localized, or does it cover a large area? On a scale of 1 to 10, with 10 being the worst and 1 being the least, how do you rate your pain? Do you have numbness, tingling, nausea, diaphoresis, shortness of breath, anxiety, or dizziness when you have chest pain?
- Have you or any member of your family ever been told that you have diabetes mellitus; cardiovascular, thyroid, or renal disease; arteriosclerosis; atherosclerosis; peripheral vascular disease; blood disorder; kidney disease; or an immune disorder such as lupus erythematosus?
- Do you become easily fatigued? Dizzy or lightheaded? Have you ever fainted?
- Do you become short of breath? When? Do you sleep on more than one pillow? Is your shortness of breath worse after physical activity? What kind of activity? Walking up steps? Does it occur when you are at rest? Does resting relieve it? Do you wake up at night short of breath or feeling like you are suffocating? Does sitting up on the side of the bed or getting up give you relief?
- Do you have a cough? What kind? Dry and hacking, or wet and productive? What does the sputum look like? Is there ever any blood in your sputum?
- Do you notice your heart beating very fast or pounding in your chest (palpitations)? Does it skip a beat?
- Have you ever fainted or felt like you were going to faint?
- Do you get up in the night to urinate? How many times do you get up each night?
- Have you noticed any sudden weight gain or swelling in the feet and legs?
- Do you experience pain in your legs when walking?
- Are your feet always cold?
- Have you ever had a bad injury to either leg?
- Have you ever had a deep vein thrombosis (DVT) or thrombophlebitis?
- What medications do you take that are prescribed by your doctor? What over-the-counter medications do you take?
- Do you smoke? Have you ever smoked? How much and for how long?
- Do you drink alcohol? What do you usually drink? How many drinks do you have? About how many times a week do you drink something alcoholic?
- What do you usually eat? Can you tell me what you generally eat for breakfast, lunch, and dinner? Do you have a midmorning, midafternoon or evening snack? What do you eat for a snack? Do you eat fast food often? What type? What do you usually drink at meals? Do you drink liquids between meals?
- Do you regularly add salt to your food?
- Do you have leg pain at night?
- Have you ever had a sore on your foot or lower leg that was slow to heal?

PHYSICAL EXAMINATION

When assessing the cardiovascular system, check for:

- Skin color, temperature, and texture
- Facial expression; signs of pain or anxiety
- Vital signs
- Heart sounds; S₁, S₂, abnormal sounds, murmurs
- Apical pulse rate and rhythm; presence of pulse deficit
- Quality of peripheral pulses
- Breath sounds, presence of crackles in lung bases
- Shape of fingers; presence of clubbing
- Appearance of neck veins; presence of venous jugular distention
- Abdomen; presence of distention; abdominal pulsation
- Degree of body tension
- Ankles and feet; presence of edema and degree
- General body appearance; presence of edema
- Weight; gain of 2 lb or more over a few days
- Varicosities in lower extremities



Think Critically About . . . How would you phrase questions about alcohol intake so that the patient would answer the questions honestly?

Physical Assessment

Guidelines for physical assessment are presented in Focused Assessment 17-1. Significant findings include abnormal or extra heart sounds, crackles in the lungs, or pink frothy sputum indicating pulmonary edema (Cultural Cues 17-1). Chest pain, if present, should be further assessed using the “PQRST” memory device (Table 17-3). Other significant findings might be a blu-



Cultural Cues 17-1

Dyspnea as the Major Symptom

African Americans often experience dyspnea as the most acute symptom during an MI. Dyspnea is more common than the more classic chest discomfort in this group. For this reason, they may delay seeking assistance.

ish cast to skin; pallor or diaphoresis (sweating); clubbing of the fingers; or pitting edema of the feet, ankles, or sacral area. There may be distended jugular veins, an abnormal rate or volume of pulses, or a pulse deficit. A pulse deficit is the difference between the apical

Table 17-3 *PQRST for Pain Assessment*

This memory device is used to assist in obtaining information from any patient experiencing chest pain or discomfort.

FACTOR	QUESTIONS TO ASK
P Precipitating events	What events or factors precipitated or caused the pain or discomfort?
Q Quality of pain or discomfort	What does the pain or discomfort feel like? Is it aching, dull, sharp, tight, heavy pressure, etc.?
R Radiation of pain	Where is the pain located? Does it radiate to the back, arms, jaw, teeth, shoulder, or elbow?
S Severity of pain	On a scale of 1 to 10, with 10 being the most severe, how do you rate the pain?
T Timing	When did the pain or discomfort begin? Has it changed since it started? Has this type of pain occurred before?

and radial pulse rate when they are counted at the same time.



Clinical Cues

Chest pain should be considered cardiac in origin until such a cause can be ruled out. Many things can cause chest pain, but it is important to always think “cardiac first.”

An apical pulse rate should be taken on all patients upon admission. Privacy should be provided before baring the chest and the room should be warm. Heart sounds are auscultated at least every 8 hours on all patients who have a known dysrhythmia or a potential for dysrhythmia, a valve problem, or heart failure (Figure 17-10). The diaphragm of the stethoscope is placed over the bare skin at the mitral area to listen to the apical pulse. S_1 (lub) and S_2 (dub) should be distinguished. S_1 occurs with the closing of the AV valve during systole. S_2 is the closure of the pulmonic and semilunar valves during diastole. Extra sounds or gallops may occur as S_3 sound. Splitting of the S_2 sound may be normal in children and young adults, but may be abnormal in adults. S_4 is usually heard just before S_1 and can indicate various heart diseases.

The bell of the stethoscope is used to listen for heart murmurs. **It must be placed lightly on the skin for the sounds to be heard.** Murmurs usually have a “swooshing” sound from turbulent blood flow. Children may have an innocent murmur that disappears as they grow. Murmurs are commonly from damaged valves, causing abnormal blood flow in the heart. As heart sounds often are very soft, ask the patient to refrain from talking, and turn off the television or radio while listening. (Just remember to turn it back on.) Having the patient roll to the left side or lean forward may make the sounds louder and clearer.



Elder Care Points

The thickening of valve leaflets with age may cause a systolic murmur common in persons older than age 80.

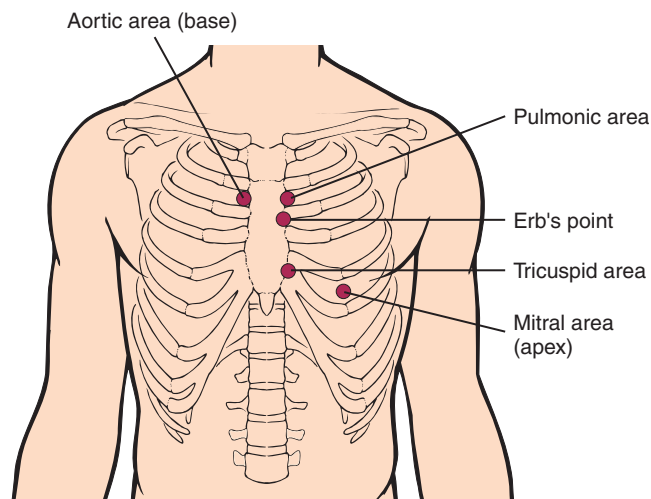


FIGURE 17-10 Sites for auscultation of heart sounds. S_1 is loudest at mitral and tricuspid areas. S_2 is loudest at aortic and pulmonic area. Listen at in the mitral area for S_3 and S_4 sounds.

Box 17-2 *Scale for Grading Pulse Quality*

- Absent
- 1+ Weak, thready
- 2+ Light volume
- 3+ Normal volume
- 4+ Full, bounding

Pulses. Check the arterial pulses and determine the pulse rate, rhythm, and character (force) of the pulse (Box 17-2). When performing a cardiovascular assessment, the radial pulse should be assessed and compared with the apical pulse. **The apical pulse should be counted for a full minute.** The carotid, femoral, popliteal, and pedal pulses should also be palpated and compared bilaterally, noting quality and character. Figure 17-11 indicates the arterial pulse sites. The pulse may be described as *normal* or *absent*, *regular* or *irregular*, *strong*, *weak*, or *thready*.

If pulsations are weak or undetectable, use a Doppler stethoscope to check them. A Doppler stethoscope measures the velocity of blood flow through a vessel with ultrasound waves. It can sense weak pulsations even in severely narrowed arteries (Figure 17-12).

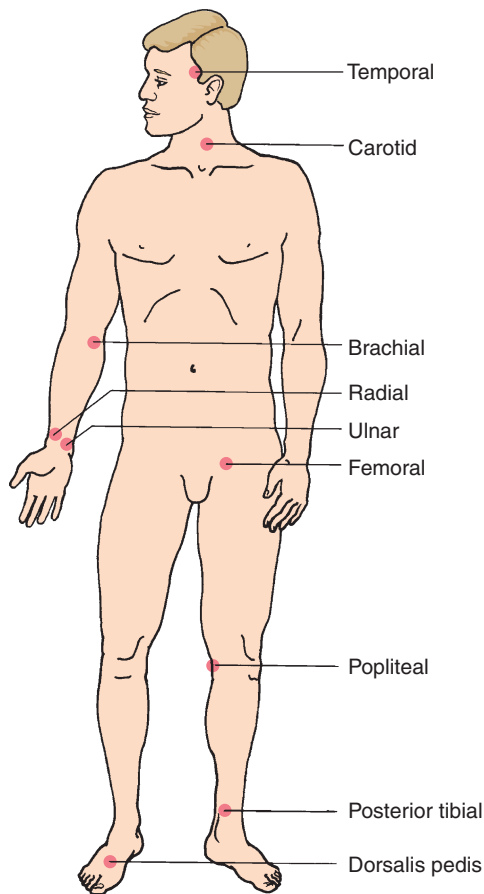


FIGURE 17-11 Palpation sites for arterial pulse.

? Think Critically About . . . Can you recall the correct way to locate a dorsalis pedis and a posterior tibial pulse? Could you demonstrate the technique to a classmate?

Examine the abdomen with the patient lying supine for a visual abdominal pulsation from the aorta. This sometimes indicates the presence of an aneurysm.

Bruits. A whooshing or purring sound is made when blood passes through a partially obstructed artery. To detect bruits, listen with the bell of the stethoscope applied lightly over the skin of the carotid arteries, abdominal aorta, and femoral arteries. Observe the jugular veins for prominence when the patient is in an upright position; this may indicate CHF.

Blood Pressure. For more accurate readings, be certain the patient has not had a cigarette or any caffeine for the past 30 minutes. Blood pressure should be carefully measured with the correct size cuff. The cuff should fit the upper arm with the lower edge 2.5 cm (1 inch) above the antecubital space. If it is too narrow, the pressure will be falsely elevated. Cuffs are available in child, normal adult, and large adult sizes. The bladder must be centered over the brachial artery, and its length should cover at least 80% of the extremity's circumference when positioned correctly. The pressure



FIGURE 17-12 The Doppler stethoscope is used to detect a faint pulse.

should be taken sitting, lying supine, and standing for a thorough assessment. Standing blood pressure measurements also are important when a patient is started on a new medication, particularly an angiotensin-converting enzyme (ACE) inhibitor. Blood pressure should be measured on both arms. The patient's arm on which the cuff is placed should be supported at heart level. The patient should be resting quietly for 5 minutes before the measurement is taken. The equipment used should be calibrated, and the valve should open and close smoothly. The cuff should be deflated slowly and smoothly to obtain a correct diastolic reading.

Orthostatic or postural hypotension is where the blood pressure drops with standing. It is a common cause of **syncope** (fainting) in older patients.



Elder Care Points

The blood pressure of the elderly patient will be lower right after a meal. For accurate readings, assess blood pressure between meals.

Skin. Tissues in light-skinned people that are receiving an adequate supply of oxygenated blood appear pink and rosy, whereas tissues deprived of normal amounts of arterial blood appear pale and mottled. In dark-skinned people, the mucous membranes will be rosy and pink if oxygenation is adequate. However, the environment must be taken into account. Pale and mottled skin also can indicate that the patient is just cold. Reddish blue color can indicate venous insufficiency.

One way to assess arterial blood flow more accurately is by having the patient elevate his or her feet and legs above the level of the heart for 1 to 3 minutes

until pallor occurs. Have the patient lower the legs to a dangling position while sitting. Compare both feet, noting the time necessary for pinkness to return (usually about 10 seconds). Note the time it takes for the veins of the feet and ankles to fill (usually about 15 seconds). For African Americans, inspect the soles of the feet for color change and use a light shining at an angle to visualize vein filling.

Return of color to the lowered feet is delayed in arterial insufficiency. If there is severe ischemia, the dangling feet soon take on a dusky red color (**rubor**). **This indicates permanent dilation of the vessels; they are no longer able to constrict as they should. In addition to being reddened, the feet and ankles may appear swollen and edematous.**

A cold environment and immobility will cause the extremities to feel cold to the touch. However, when a patient experiences persistent coldness of an extremity in a warm environment, arterial insufficiency should be suspected. When observing a patient for signs of arterial disease, the nurse should note differences in skin temperature in various areas of the same limb, as well as differences between limbs.

Skin that is chronically malnourished because of decreased blood supply has a characteristic appearance: it appears smooth, shiny, and thin, and there is little or no hair on its surface. The nails are thick with deposits of thick, cornlike material under them.

Hair loss is a natural occurrence with aging, as is thickening of fingernails and toenails. These signs are not reliable indicators of vascular problems of the extremities in the elderly.

If there is severe malnutrition of the tissues for several days, the tissues become necrotic. This causes the skin to assume a purple-black color. This is a deep cyanotic condition indicative of gangrene. Gangrene of the toes is not an uncommon complication in the diabetic patient who has poor circulation in the feet.

Chronic venous insufficiency is accompanied by chronic edema. This in turn leads to inflammation of the tissues (**cellulitis**) and eventually to the formation of ulcers. Edema is either present, absent, pitting, or non-pitting. Pitting means that a fingertip pressed into the area for 5 seconds leaves an indentation. Increased pigmentation of the skin, dryness and scaling, and excoriations are objective signs of venous insufficiency.

The capillary refill test has traditionally been used to check peripheral circulation. A fingernail or a toenail is squeezed over the bed of the nail sufficiently to cause blanching; the pressure is removed and an observation of how quickly the color returns is made. Normally the color returns immediately. Although it is a good gross assessment of circulation to the extremity, this test is unreliable as many factors can cause a decrease in time for color to return. This test is most useful for determining whether circulation is occluded by constriction or thrombosis above the area. Review Chapter 3 for assessment and staging of edema.

Homans' sign is tested by having the patient raise the leg with the knee bent, then straightening the leg and dorsiflexing the foot as the leg is lowered to the bed. A positive Homans' sign may indicate a deep venous thrombosis.

Nursing Diagnosis

Table 17-4 presents general nursing diagnoses and nursing interventions for patients experiencing cardiovascular problems. Nursing diagnoses may be added to the care plan for problems secondary to treatments, such as drug therapy or surgery. Additional nursing diagnoses that also may apply include:

- Risk for infection related to inflammation of lining of heart structures
- Anxiety related to life-threatening disease
- Sleep pattern disturbance related to pain in the legs while at rest
- Chronic low self-esteem related to activity intolerance or inability to perform usual roles because of chronic leg ulcers

Planning

General nursing goals for care of patients with cardiovascular disease are:

Cardiac

- Prevent death and complications
- Monitor for complications
- Promote adequate oxygenation
- Alleviate or control pain
- Decrease fear and anxiety
- Balance activity and rest to prevent fatigue and provide adequate tissue perfusion
- Assist with activities of daily living (ADLs) until patient can resume self-care
- Educate regarding disease, surgery, treatments, and self-care
- Promote adjustment to condition
- Promote rehabilitation and return to wellness
- Obtain assistance with home maintenance as needed

Vascular

- Promote vascular integrity
- Decrease risk factors for vascular disease
- Maintain blood pressure within normal limits
- Improve circulatory function
- Prevent thrombosis and embolism
- Maintain or restore tissue integrity
- Prevent the complications of leg ulcers and gangrene

A goal of community nursing is the promotion of healthful living to prevent cardiovascular disease. A concerted effort is being made to decrease childhood obesity as a method of decreasing cardiovascular disease in adulthood.

When planning care for cardiovascular patients, it is important to schedule nursing activities to conserve

Table 17-4 *Common Nursing Diagnoses and Interventions for Patients with Heart Disorders*

NURSING DIAGNOSIS	GOALS/EXPECTED OUTCOMES	INTERVENTIONS
CARDIAC DISORDERS		
Activity intolerance related to decreased perfusion	Patient will not experience undue fatigue with activity as evidenced by changes in vital signs.	Space activities of daily living and nursing procedures to prevent undue fatigue. Encourage use of oxygen as ordered. Implement actions to promote rest.
Risk for injury related to dysrhythmia or complications of MI or CHF	Patient will not experience myocardial infarction or congestive heart failure as a result of dysrhythmia.	Monitor ECG or telemetry tracings, observing for changes and life-threatening dysrhythmias. Assess for complications: <ul style="list-style-type: none"> • Monitor lungs for crackles. • Check for jugular venous distention. • Auscultate for changes in heart sounds, extra sounds, changes in rhythm. • Assess respirations for increasing dyspnea. • Assess for signs of inflammation or infection; check temperature trend, WBCs. • Assess for chest pain upon exertion or at rest. • Monitor for central and peripheral edema. • Assess trends in daily weight. • Assess trends in 24-hour intake and output. • Monitor vital signs.
Decreased cardiac output related to dysrhythmia or ineffective cardiac muscle	Patient will demonstrate adequate cardiac output as evidenced by normal pulses, vital signs, skin color, and urine output.	Assess apical pulse every shift. Administer antidysrhythmic and cardiotonic medications, as ordered. Observe for side effects of medications. Assess for adequate perfusion: <ul style="list-style-type: none"> • Check peripheral pulses. • Assess color of extremities and around mouth. • Assess mentation. • Monitor urine output (related to perfusion of kidneys). • Auscultate lungs for crackles every shift. • Assess level of fatigue. • Treat impaired oxygenation and fluid imbalance.
Impaired gas exchange related to cardiac failure	Patient will not experience impaired oxygenation; SaO_2 will be within normal limits; Po_2 between 80 and 100.	Place in high Fowler's position. Administer oxygen, as ordered. Feed frequent small meals to decrease oxygen demand. Administer diuretics as ordered. Monitor intake and output. Enforce fluid restrictions. Assist with ADLs. Promote relief of anxiety. Give morphine, as ordered, to ease breathing and decrease anxiety. Monitor lung sounds, pulse oximetry, and blood gases. Assist to use incentive spirometer q 2 hr, as ordered. Provide measures to drain pulmonary fluid, as ordered; i.e., postural drainage, suction, nebulizer treatments.
Self-care deficit, bathing, toileting, grooming, and dressing related to fatigue, weakness, or dyspnea	Patient will increase performance of own ADLs of 1 to 3 METs within 1 wk. Patient will not experience constipation.	Assist with all ADLs as needed. Plan nursing treatments to provide rest periods. Encourage to do small tasks of ADLs as condition improves. Assist to turn in bed every 2 hr. Assess skin every shift and when turning. Provide mouth care before meals to stimulate appetite. Give stool softeners or laxatives, as ordered, to prevent straining at stool (Valsalva maneuver).

Continued

Table 17-4 Common Nursing Diagnoses and Interventions for Patients with Heart Disorders—cont'd

NURSING DIAGNOSIS	GOALS/EXPECTED OUTCOMES	INTERVENTIONS
CARDIAC DISORDERS—cont'd		
Fear related to life-threatening illness	<p>Patient will verbalize feelings and fears regarding life-threatening condition.</p> <p>Patient will identify own best coping mechanisms.</p>	<p>Perform a spiritual assessment.</p> <p>Determine usual coping style.</p> <p>Support in coping mechanisms.</p> <p>Obtain clergyman if patient desires contact.</p> <p>Provide privacy for prayer and devotions.</p> <p>Assist to ventilate fears to reduce anxiety.</p> <p>Keep informed of what is being done for treatment and what to expect.</p> <p>Inform of positive gains toward wellness.</p> <p>Allow state of denial in acute stage as denial may be protective.</p> <p>Provide time with loved ones.</p> <p>Provide therapeutic touch if patient is accepting.</p> <p>Assess cultural meanings of events to patient.</p> <p>Actively listen to the patient's fears and concerns.</p> <p>Offer realistic reassurance as appropriate.</p>
Impaired home maintenance management related to fatigue, dyspnea, and activity intolerance.	Appropriate home services will be in place before discharge.	<p>Refer for social services consult.</p> <p>Consider home health care services.</p> <p>Offer information on homemaker aide services.</p> <p>Consult with family regarding ongoing care of patient at home.</p> <p>Collaborate with patient regarding plans for home care.</p>
VASCULAR DISORDERS		
Ineffective tissue perfusion related to: Vascular damage	Patient's blood pressure will be within normal range within 3 mo.	<p>Assess blood pressure; determine effectiveness of therapy.</p> <p>Administer medications to lower blood pressure.</p> <p>Discourage intake of caffeine and excess sodium.</p> <p>Discourage smoking.</p> <p>Teach to arise slowly and stabilize before walking to counteract postural hypotension effect from medication.</p> <p>Teach anxiety- and tension-reduction techniques to decrease blood pressure.</p> <p>Encourage regular rest, relaxation, and exercise program.</p>
Obstructed blood flow	<p>Patient will not develop other deep vein thromboses.</p> <p>Thrombosis will resolve within 10–14 days</p>	<p>Assess for signs and symptoms of deep vein thrombosis and impaired blood flow.</p> <p>Maintain activity restrictions as ordered.</p> <p>Elevate affected extremity as ordered.</p> <p>Increase fluid intake to 3000 mL/day unless contraindicated.</p> <p>Administer anticoagulants as ordered; monitor for side effects.</p> <p>Teach to prevent future episodes by encouraging not to sit with legs crossed, not to sit for long periods, and not to put pressure on the back of the knees.</p> <p>Apply elastic stockings or sequential pneumatic devices to promote venous return.</p>
Surgical revascularization	Patient will not develop thrombosis.	<p>Check incisions for bleeding q 1-2 hr × 24 hr then q 4 hr × 6, then q shift.</p> <p>Assess for internal hematoma by checking sensation below surgical area.</p> <p>Assess for adequate blood flow by checking pulses distal to incision on same schedule.</p> <p>Assess skin color and temperature above and below incision when checking for bleeding.</p> <p>Reinforce dressing as needed; change dressing per orders, using strict aseptic technique.</p>

Table 17-4 Common Nursing Diagnoses and Interventions for Patients with Heart Disorders—cont'd

NURSING DIAGNOSIS	GOALS/EXPECTED OUTCOMES	INTERVENTIONS
VASCULAR DISORDERS—cont'd		
Pain related to decreased blood flow and edema	Patient will verbalize adequate pain control attained from analgesics and comfort measures provided.	<p>Assess type and location of pain experienced.</p> <p>Handle gently and avoid jarring the bed.</p> <p>Use a bed cradle or footboard to prevent pressure from bed linens.</p> <p>Administer analgesics and antiinflammatory agents as ordered.</p> <p>Apply heat as ordered; monitor closely to prevent burns.</p> <p>Teach relaxation techniques, imagery, or distraction to decrease pain.</p> <p>Elevate edematous extremity.</p> <p>Apply elastic stockings or sequential pneumatic devices to encourage venous return and decrease edema.</p> <p>Medicate for sleep as ordered if discomfort is interfering with rest.</p>
Activity intolerance related to pain in legs when walking	<p>Patient will develop own activity program within 3 wk.</p> <p>Patient will exercise regularly according to devised program.</p>	<p>Collaborate with physical therapist to encourage prescribed exercises.</p> <p>Assist to plan walking swimming, or cycling program.</p>
<p>Body image disturbed related to:</p> <p>Diagnosis of chronic illness</p> <p>Edema and dilated veins in the legs</p> <p>Loss of limb by amputation</p> <p>Inability to maintain former lifestyle</p>	<p>Patient will verbalize feelings regarding diagnosis, body changes, and needed lifestyle changes.</p> <p>Patient will identify personal strengths and coping mechanisms.</p> <p>Patient will become as independent as possible in tasks of daily living (within 2 mo).</p>	<p>Allow to ventilate feelings about illness and disease process.</p> <p>Assist through the grief process.</p> <p>Assist to identify personal strengths.</p> <p>Reinforce coping mechanisms that have been helpful before.</p> <p>Be with patient for first dressing change.</p> <p>Clarify misconceptions about physical limitations after amputation.</p> <p>Involve patient in care of the wound after initial period of adjustment. Foster independence in tasks of daily living.</p> <p>Assist to explore lifestyle changes.</p> <p>Encourage significant others in their support of the patient.</p> <p>Teach ways to decrease risk of further amputation.</p> <p>Use strict aseptic technique for wound care.</p> <p>Treat and dress wound per physician's orders.</p> <p>Promote adequate nutrition to promote healing.</p> <p>Administer medication, as ordered, to prevent infection.</p> <p>Position affected limb, as ordered.</p> <p>Maintain correct body alignment.</p> <p>Inspect pressure points every 2 hr.</p> <p>Turn at least every 2 hr.</p> <p>Maintain smooth linens on bed, provide appropriate padding to prevent pressure areas.</p> <p>Keep skin clean and dry.</p> <p>Refrain from raising the knee section of the bed.</p> <p>Encourage foot and ankle exercises every hour while patient is awake.</p> <p>Prevent shearing when patient is moving in bed by using a lift sheet and two people to turn the patient.</p> <p>If skin breakdown occurs, notify physician immediately and provide appropriate wound care.</p>
<p>Impaired tissue integrity related to:</p> <p>Ulcer from decreased circulation</p> <p>Surgical wound</p> <p>(Risk for infection may be used here also)</p>	Patient will not develop a wound infection.	
Risk for impaired tissue integrity related to bedrest and impaired circulation	Patient will not develop impaired tissue integrity.	

Continued

Table 17-4 Common Nursing Diagnoses and Interventions for Patients with Heart Disorders—cont'd

NURSING DIAGNOSIS	GOALS/EXPECTED OUTCOMES	INTERVENTIONS
VASCULAR DISORDERS—cont'd		
Knowledge deficient related to inadequate information about disease process, medications, and self-care	Patient will verbalize knowledge of disease process and ways to prevent further damage. Patient will verbalize how to take medications and side effects to report. Patient will demonstrate self-care techniques.	Explain what is happening in the body to cause the decreased blood flow. Allow time for questions. Instruct in ways to decrease risk factors. Teach self-care methods, including exercises, skin care, foot care, dietary changes, lifestyle changes. Teach about medications including: schedule of administration, action, side effects, what to report to the physician. Encourage regular visits to the doctor.
Noncompliance related to refusal to follow treatment regimen	Patient will verbalize frustrations and problems in complying with treatment regimen and lifestyle changes. Patient will demonstrate compliance with treatment regimen.	Reinstruct about disease process. Explore problems with treatment regimen. Allow to express feelings about lifestyle changes. Explore ability to obtain and afford medications. Explore any difficulty in swallowing medications. Explain progression of disease and consequences of poor control; discuss complications and impact on lifestyle. Seek support system for compliance with treatment program. Give praise for each attempt at compliance. Respect the patient's right to make decisions about compliance.
Risk for injury related to: Embolus or bleeding from anticoagulant medication	Coagulation times will remain within safe therapeutic range. Patient will have no signs of bleeding. Patient will have no signs of embolus.	Do not massage affected extremity. Encourage activity restrictions as ordered. Monitor laboratory values: PT or APTT and notify physician when values are outside of accepted therapeutic limits. Assess urine and stool for signs of blood. Assess patient for excessive bruising; bleeding gums, nosebleeds, bleeding at puncture sites. Check injectable anticoagulant dosages and IV admixtures with another nurse before administration to verify correct ordered dosage and rate of infusion. Assess for signs of embolus: chest pain, shortness of breath, change in level of consciousness, sudden headache, or other neurologic signs.
Circulatory occlusion from embolus		

the strength of the patient and prevent excessive fatigue. Patients undergoing telemetry monitoring should not be disconnected from their monitor for any extended time. Check to see whether it is all right to disconnect the device before having the patient shower. **Reconnect the leads immediately afterward.**



Clinical Cues

If you detach the cardiac monitor without alerting the person monitoring the telemetry monitors, they may think the patient's heart has stopped beating and call a "code." Always alert the monitor watcher when you remove the patient from telemetry and when you reattach the leads. That way they know that they need to watch that screen again.

Planning the timing of medication administration is necessary because many patients prefer to take cardiovascular medications with food in their stomach. If medications are due when a meal is not scheduled,

plan to take some juice to the room with the medications. Always check to see that the medication can be taken with food before administering with juice or milk.



Clinical Cues

Know what the patient's last blood pressure and pulse measurements were before going to the room with cardiovascular medications. Often you will need to take an apical pulse rate and blood pressure reading before administering certain medications. You need to know what those measurements had been previously in order to evaluate the patient's status properly. Plan time to take these measurements and record them.

When a patient has a history of thrombosis, the nurse must plan measures to prevent recurrence regardless of what patient problem is currently the focus of treatment. If the patient has arterial insuffi-

ciency, the nurse should be alert to prescribed medications that may cause further vasoconstriction.

Appropriate exercise is important to treat vascular disease, and the nurse collaborates with the physical therapist about activity, exercises, and the reinforcement of teaching. Collaboration with the dietitian is vital to the patient who has atherosclerosis and a high cholesterol count. Specific expected outcomes must be written on an individual basis. Examples are included in Table 17-4.

Implementation

A large part of what the nurse does for the patient with a cardiovascular disorder is to monitor the condition and determine whether treatment is effective. Considerable time is spent on teaching patients about the disease, self-care, and medications. Monitoring side effects or adverse effects of medication is very important.

Remember that any patient experiencing fatigue or weakness takes longer to accomplish the tasks of daily living. Space nursing actions appropriately. Place patient in an upright position to administer oral medications. It is especially important that the elderly patient be upright to aid swallowing; have the patient take a sip of water to wet the throat and then give the medication.

Watch the patient receiving cardiac drugs for postural hypotension; have her hold onto the bedrail and steady herself for a couple of minutes after arising before beginning to walk. This will help prevent falls.

Appropriate nursing interventions are discussed with the various disorders in the following chapters. Specific nursing interventions for common nursing diagnoses related to cardiovascular conditions also are found in the nursing care plans in those chapters and in Table 17-4.

Collaboration

Cardiovascular patients often are being treated by the physical therapist, dietitian, and respiratory therapist, as well as the physician and nurse. It is important that the nurse consult with the other health professionals involved in the patient's care. Early collaboration with the discharge planner is important to provide continuity of care after discharge. The nurse's work will go more smoothly if it is possible to plan when other health professionals see the patient. Providing others on the health care team with information useful to them promotes a good working relationship.

Evaluation

Evaluation involves both subjective and objective data. This means that good communication skills must be used to ask the right questions and gather the required information from the patient. Ask the patient to describe any "different" feelings she has experienced. Inquire about changes in appetite and bowel movements that could indicate possible medication toxicity. Check laboratory values for therapeutic drug levels before giving doses of medication, and note the latest

blood levels of electrolytes. Assess for signs and symptoms of toxicity and fluid or electrolyte imbalance. Ask yourself whether the patient is showing signs indicating that the medication you are giving is effective. The nursing care plan should be checked daily to evaluate whether each nursing action is effective. If an action is ineffective over time, it should be deleted and a new action should be devised to resolve the problem.

It is important to look at serial blood pressure readings to evaluate the effectiveness of treatment and of nursing interventions. Pressures that are consistently higher than normal in between medication doses indicate a need to change either the dosage schedule or the medication.

Carefully evaluating pulses and comparing them bilaterally is an important part of nursing care for patients with problems of the cardiovascular system. Writing a good description of the quality and character of the pulses monitored in the nurse's notes will give coworkers an accurate assessment baseline on which to evaluate changes in the pulse.

It is important to determine if skin color and temperature have changed since the last assessment. Areas of discoloration should be accurately measured and documented in the nurse's notes. Ulcerated areas are monitored closely and are measured to determine whether healing is occurring. The color of the healing tissue and presence of exudate also are evaluated. If the wound is growing or not improving, the nursing actions or treatment must be changed.

Often the nurse must rely on subjective data from the patient to evaluate whether treatment and nursing actions are effective. Increases in peripheral circulation may be evident only by a decrease in pain or an ability to walk further without pain.

COMMON PROBLEMS OF PATIENTS WITH CARDIOVASCULAR DISORDERS

FATIGUE AND DYSPNEA

In the early stages of heart disease, the patient may be only slightly aware of the inability to do as much physical work as she formerly could. If she lets the problem go too long, she will find that physical activities will become increasingly restricted, because she will lack the energy to perform the simplest of tasks and will become short of breath after the slightest exertion.

When the coronary arteries fail to supply adequate oxygen to the cells of the heart muscle, the heart is unable to perform as it should when extra demands are placed on it. The result is a general hypoxia of the tissues throughout the body, which causes fatigue and dyspnea on exertion.

Traditionally, prolonged bedrest was prescribed for every patient with a heart condition. Currently, bedrest with bedside commode privileges is ordered for the first 24 to 72 hours for MI and severe CHF. The

patient may feed herself and assist with her sponge bath. She should be cautioned against any isometric activity, such as pushing up in bed. Stool softeners are given to prevent straining at stool (Valsalva maneuver), which causes a sudden increase in cardiac workload (Felker, 2006). Straining while coughing or repositioning in bed can cause the Valsalva as well and is to be avoided. Activity progresses to chair sitting, ambulating to the bathroom, and then down the hall. Patients are monitored by telemetry units to watch for dysrhythmias or excessive heart rate changes during ambulation. The amount of energy used in activity is expressed in *metabolic equivalents* (METs). The patient is guided from 1 to 3 METs before discharge. Sitting, eating, washing hands and face, and conversing are 1 to 3 MET activities. Box 17-3 shows the metabolic equivalents for various activities.

Criteria used to determine whether the patient is tolerating the activity include the following:

- The heart rate does not rise more than 20 beats per minute.
- Systolic blood pressure does not drop.
- There is no complaint of chest pain, dyspnea, or severe fatigue.
- There is no abnormal heart rate or rhythm.

Activity progression often is jointly supervised by a physical therapist and a nurse. More information on cardiac rehabilitation is presented in Chapter 9.

FLUID OVERLOAD: EDEMA

Edema is an accumulation of fluid in the interstitial fluid compartment. It becomes a problem in heart disease when the blood flow into or out of the heart is inhibited, causing a slowing down of the normal movement of body fluids and their eventual excretion.

Continually assess the fluid balance of a patient with cardiac disease by looking for signs of abnormal collections of fluid in the body tissues. Daily weight change is considered the best indicator of fluid buildup. The feet and ankles of ambulatory patients are checked for signs of dependent edema, and bed-rest patients are watched for signs of swelling in the area of the sacrum, buttocks, and thighs. The patient is observed for progressive signs of shortness of breath, and lung fields are auscultated each shift to detect crackles, a sign of beginning pulmonary congestion.



Clinical Cues

A weight gain of 3 lb or more in a 24-hour period indicates fluid retention.

Nursing responsibilities include recording the patient's weight daily before breakfast, supervising fluid restriction, accurately measuring intake and output, and assessing for signs of both fluid deficit and fluid

Box 17-3 Energy Expenditure in Metabolic Equivalents

	CALORIES BURNED
LOW-ENERGY ACTIVITIES (Less Than 3 METs or Less Than 3 cal/min)	
Activities in Hospital	
Resting supine	1.0
Sitting	1.2
Eating	1.4
Conversing	1.4
Washing hands, face	2.5
Activities Outside Hospital	
Sewing by hand	1.4
Sweeping floor	1.7
Painting, sitting	2.5
Driving car	2.8
Assembling radio	2.7
Sewing by machine	2.9
MODERATE-ENERGY ACTIVITIES (3–6 METs or 3–5 cal/min)	
Activities in Hospital	
Sitting on bedside commode	3.6
Walking at 2.5 mph	3.6
Showering	4.2
Using bedpan	4.7
Walking at 3.75 mph	5.6
Activities Outside Hospital	
Bricklaying	4.0
Tractor plowing	4.2
Ironing, standing	4.2
Mopping floor	4.2
Bowling	4.4
Cycling at 5.5 mph on level ground	4.5
Golfing	5.0
Dancing	5.5
HIGH-ENERGY ACTIVITIES (6–8 METs or 6–8 cal/min)	
Ambulating with braces and crutches	8.0
Performing carpentry	6.8
Mowing lawn by hand	7.7
Playing singles tennis	7.1
Riding on trotting horse	8.0
Walking at 5 mph	6.5
Ascending stairs	7.0

Adapted from Lewis S.M., Heitkemper M.M., Dirksen S.R. (2007). *Medical-Surgical Nursing*, 7th ed., St Louis, Mosby.

overload. Elderly patients on fluid restriction and diuretics can easily become dehydrated.

Therapeutic measures to control edema include the administration of diuretics and restriction of sodium and, possibly, fluid. You must observe for adverse effects of medication, such as electrolyte imbalance and postural hypotension. Potassium supplementation may be ordered for the patient who is experiencing hypokalemia (Safety Alert 17-1).

PAIN

Severe pain is most often associated with heart disease of an acute nature (e.g., MI). Anginal pain caused by narrowed coronary arteries can interfere with the patient's lifestyle, as well as cause discomfort. Acute



Safety Alert 17-1

Be Alert for Hypokalemia

Be alert for the following signs of hypokalemia: fatigue, muscle weakness, muscle cramps, drowsiness, confusion, new onset of bradycardia, or postural hypotension. Hypokalemia may cause life-threatening cardiac dysrhythmia.

anginal pain is treated with nitroglycerin, oral nitrates, oxygen, reassurance, and careful monitoring for relief. Nitrates and other medications that dilate coronary arteries to promote better blood flow and decrease ischemia are used to control or prevent anginal pain.



Clinical Cues

If chest pain is not relieved after administering three nitroglycerin sublingual tablets 5 minutes apart, notify the physician. Institute oxygen therapy according to agency protocol, monitor vital signs, and stay with the patient. The patient may be experiencing an MI. (Do check to make certain that the nitroglycerin causes tingling under the tongue. If not, the tablets are too old and will not work.)

If pain is not relieved, the analgesic drug used most often in an emergency situation is morphine sulfate, as it decreases both anxiety and cardiac workload, as well as alleviates pain (Webb, 2000). The drug is given IV initially for quick pain relief. As the acute phase and severe pain subside, these drugs may be replaced with oral dosages or milder sedatives that promote relaxation and freedom from anxiety.

The patient's pain may be increased because of nervousness and anxiety, and you can do much to help relieve pain by providing a restful environment, interacting therapeutically with "active listening," and balancing rest with prescribed physical activity.

Pain can be a symptom of a life-threatening heart event. Each episode of pain is carefully assessed by noting when it started, the location and radiation pattern, degree on a scale, activity prior to onset, associated symptoms such as nausea, diaphoresis, or **palpitations**, and vital signs.

Sleep deprivation and fatigue can increase the pain. Turning, administration of medications, visiting, exercise, and other procedures should be coordinated so that the patient is not disturbed more than necessary.

Determining those factors that seem to trigger an attack can identify stressors that the patient may be able to avoid. Relaxation and other noninvasive techniques to manage pain are discussed in Chapter 7.

ALTERED TISSUE PERFUSION

In peripheral vascular disease, blood flow may be altered by constriction of the vessels or by sluggish blood flow. The smooth muscles of the arterial walls respond to temperature by constricting in the presence of cold and extreme heat and relaxing in the presence of warmth. Therefore the nurse's care plan should include (1) providing a warm environment for the patient; (2) covering the hospitalized patient with warm blankets; dressing her in warm clothing; and (3) instructing the patient to avoid extremes of cold and heat.

The constricting effect of extreme heat rules out the use of local applications in the form of hot water bottles. In addition to the danger of burning the patient because of decreased sensitivity to extremes of temperature, local heat increases metabolic activity in the tissues to which it is applied and therefore upsets even more the balance of supply and demand for blood flow to all the tissues.

The goal in application of additional warmth is even distribution throughout the body.



Think Critically About . . . What would you recommend to the elderly home care patient to keep his lower extremities warm during the winter? The patient does not have the funds to keep the house heated above 68° F.

A second consideration is that of *pressure* against the walls of the blood vessels. Constricting clothing is avoided, particularly circular garters and elastic materials in underclothing. Frequent position changes are essential; position must be changed at least every 2 hours.

The patient with poor venous circulation can benefit from periodic elevation of the lower extremities to facilitate venous return of blood to the heart. Elevation above the level of the heart is preferred.

Even, well-distributed support of the vessels near the surface of the body will help improve venous return. To provide this kind of support, the physician may prescribe an elastic bandage or fitted elastic stockings. The stockings or elastic bandage should be applied early in the morning, before the legs are placed in a dependent position, because the blood vessels are less congested after a prolonged rest. Bandages and hose should be applied by beginning at the feet and working upward to avoid trapping blood in the lower leg. The patient should have two pair of elastic hose and should wash them after each day's wearing. Elastic hose should be replaced every 6 months as they lose their elasticity. When stockings are removed, the heels should be checked for pressure areas. **Elastic stockings are not used for patients with arterial disorders.**

Exercise is especially beneficial to patients with decreased blood flow. Walking is ideal exercise for the

ambulatory patient. Bed-ridden patients will need range of motion (ROM) exercises and the other kinds of muscular movements described in Chapter 9. Use of a treadmill for patients who cannot exercise by walking outside is very beneficial. An Exercycle is another alternative.

In addition to mechanical factors, certain chemical factors affect the constriction of blood vessels. *Nicotine*, which is inhaled with tobacco smoke, has the effect of producing spasmodic narrowing of the peripheral arteries. Patients with arterial insufficiency are encouraged to stop smoking. Used in conjunction with a community stop smoking support program, the booklet *You Can Quit Smoking*, available from the Agency for Health Care Research and Quality Publications Clearinghouse (540 Gaither Rd., Rockville, MD 20850), can be very helpful.

? Think Critically About . . . Can you describe the specific actions you would take to help a patient recognize the need for and to establish a “quit smoking” program?

Alcohol is a mild vasodilator when taken in moderate amounts (Health Promotion Points 17–3). Unless the patient has moral or religious convictions against its use, the physician may approve a daily intake of a specific, small amount of wine or liquor. It is important to find out whether alcohol will interfere with the action of medications being taken.

Drugs that are helpful to relieve vasoconstriction and improve blood flow are prescribed. These drugs are of value only when the arteries are still capable of dilating. Severely sclerosed vessels respond very poorly to therapy of this kind. Some think that vasodilators may actually be harmful because they shunt blood away from the zone of ischemia to well-perfused tissues.

Sympathectomy is a surgical technique that may be used to relieve vasoconstriction. Because this procedure severs sympathetic nerve fibers supplying the peripheral vessels, it is of benefit only to those patients who do not have advanced pathologic changes in these vessels.

IMPAIRED TISSUE INTEGRITY

Tissues that have a diminished blood supply are subject to severe and permanent damage from the slightest injury, because the normal processes of healing and repair are impaired. Arterial and venous stasis often lead to chronic leg ulcers.

These ulcers are particularly distressing to the patient because they heal very slowly and many never completely heal. Patients must be taught to avoid conditions that contribute to injury of the extremities and to report any injury, no matter how minor.



Health Promotion Points 17–3

Drink in Moderation

Promote proper use of alcohol for those who do consume alcoholic beverages. Moderate alcohol intake for a man is two drinks in any one day. For a woman, the appropriate amount is one drink per day. One drink is 1½ ounces of alcohol, 4 ounces of wine, or 12 ounces of beer.

Prevention of leg ulcers includes (1) wearing elastic bandages or support hose; (2) proper positioning and exercise; (3) avoiding injury to the feet and legs; and (4) avoiding extremes of heat and cold and other mechanical and chemical factors that contribute to obstruction of blood flow. Information on care of the patient with a venous stasis ulcer is in the next chapter.



Key Points

- Cardiovascular disease is the leading cause of death in the United States.
- Cardiac and vascular disorders cause considerable disability.
- The heart and vessels become stiffer with age and there is less cardiac reserve.
- Atherosclerosis and arteriosclerosis are major contributors to cardiovascular disease.
- Close to a third of the population in the United States has elevated blood pressure.
- Many risk factors for cardiovascular disease are modifiable.
- Control of hypertension and obesity could lower the incidence of cardiovascular disease.
- Understanding diagnostic tests for the cardiovascular system will assist you to prepare and care for patients properly.
- Good interview skills help you to obtain comprehensive data for a cardiovascular assessment.
- Physical data gathering involves a variety of techniques for assessment of the cardiovascular system (Focused Assessment 17–1.)
- Peripheral pulses should be compared bilaterally.
- Blood pressure should be taken, using correct technique, lying, sitting, and standing.
- Skin color and texture can tell much about cardiovascular status.
- Comprehensive nursing care plans should be holistic and may need to include problems secondary to the cardiovascular disease.
- Planning should include time management, as many heart medications need to be given as close to the prescribed time as possible to maintain a steady blood level of the drug.
- Collaboration with other health care team members assists in providing consistent, thorough care for the patient with a cardiovascular disorder.

- Evaluation involves checking blood levels of electrolytes, lab values for cardiac drugs to determine adequate dosing or toxicity, and monitoring blood counts for adequate red cells and hemoglobin to carry sufficient oxygen to the tissues of the body.
- Fatigue and dyspnea occur when the heart cannot pump sufficiently to carry adequate oxygen and nutrients to the tissues.
- Activity during cardiac rehabilitation is measured in metabolic equivalents; activity is started slowly and may progress according to the body's response.
- Heat therapy is applied cautiously to extremities of patients with peripheral vascular disease.
- When blood flow out of the heart is inhibited, there is a slowing of normal movement of body fluids and their excretion, causing edema.
- Daily weight change is the best indicator of fluid buildup.
- Watch patients who have fluid imbalances for accompanying electrolyte imbalances.
- Measures to reduce or prevent edema are often needed for the patient with peripheral vascular disease.
- Pain from an MI is acute in nature.
- Nitroglycerin and morphine are the drugs of choice for myocardial pain.
- Anginal pain is treated with nitroglycerin and other drugs to promote arterial vasodilation.
- Decreasing anxiety and promoting rest may decrease anginal pain.
- It is very important to encourage the patient with cardiovascular disease to quit smoking, as nicotine is a vasoconstrictor.
- Patients with peripheral vascular disease have difficulty healing lower leg and foot wounds.



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NCLEX-PN EXAM STYLE REVIEW QUESTIONS

Choose the best answer(s) for the following questions.

- Which of the following statements are true regarding drug use and the risk of cardiac disease? (*Choose all that apply.*)
 - The vasodilation effects of cocaine hasten atherosclerosis.
 - Sudden cardiac death is associated with cocaine use.
 - Methamphetamine dilates blood vessels.
 - Cigarette smoking contributes heavily to heart disease.
 - Methamphetamine potentially causes myocardial infarction.
- The nurse compares the blood pressure taken at the ankle with that taken at the arm to evaluate the circulatory status in the lower extremities. This procedure is known as:
 - retrograde filling test.
 - ankle-brachial test.
 - Doppler flow studies.
 - Allen's test.
- _____ is a common manifestation of arterial insufficiency to the lower extremities that is described as muscle cramping brought on by exercise and relieved by rest.
- During initial assessment of an older adult, the nurse found that the skin appears smooth, shiny, thinned, with little or no hair on the surface. Which is the most appropriate nursing diagnosis?
 - Ineffective tissue perfusion
 - Risk for infection
 - Disturbance in body image
 - Fluid volume deficit
- When taking care of a patient with cardiac disease, the nurse teaches the importance of decreasing the cardiac workload. Which of the following nursing interventions would reinforce patient instructions?
 - Caution against pushing up in bed.
 - Prevent straining at stool.
 - Encourage coughing.
 - Promote exercise and progressive activity.
- The nurse weighs a patient with congestive heart failure and determines that there is a net weight gain of 5 pounds within the last 24 hours. Which of the following nursing interventions is most appropriate?
 - Administering diuretics
 - Restricting of potassium intake
 - Monitoring pulse oximetry
 - Forcing oral fluids
- The nurse administers two consecutive sublingual nitroglycerin tablets to a patient who is complaining of moderate chest pain. The patient's blood pressure is 110/70 mm Hg; an appropriate nursing action would be to:
 - administer morphine sulfate.
 - start a 500 mL fluid challenge.
 - give another sublingual nitroglycerin.
 - provide emotional support.

8. When interviewing a patient complaining of moderate chest pain, an appropriate question would be: *(Choose all that apply.)*

1. Who witnessed the pain?
2. What does the pain or discomfort feel like?
3. What relaxation strategies were implemented?
4. Where is the pain located?
5. Where does the pain radiate?

9. The nurse assesses the older adult who complains of easy fatigability. Which of the following clinical findings is associated with aging?

1. Hypertension
2. Confusion

3. Muscle atrophy
4. Diastolic murmur

10. As the nurse prepares to administer a dose of losartan (Cozaar) the patient asks, "What does this medication do?" An accurate statement by a student nurse would be:

1. "The medication blocks the effect of a potent vaso-constrictor."
2. "The medication stimulates angiotensin secretion."
3. "The medication slows your heart rate."
4. "The medication stimulates the production of red blood cells."

CRITICAL THINKING ACTIVITIES ?

Read each clinical scenario and discuss the questions with your classmates.

Scenario A

Debra Johnson, a 20-year-old African American college student on your campus, comes to the health center complaining of frequent headaches. The assessment data shows that she is 5' 4" tall, weighs 149 lb Temp. 98.8, P = 82, R = 14, and BP 138/84. She smokes about a half a pack of cigarettes a day. She has a heavy academic schedule and rarely exercises. She eats a lot of "food on the run" at the local fast food places. Her mother and uncle both have hypertension.

1. Which of her data is abnormal for her age?
2. What risk factors does she have for cardiovascular disease?
3. Which risk factors are modifiable?

Scenario B

Aiko Sukura, a 64-year-old man, comes into the ER after experiencing chest pain and diaphoresis. His EKG is abnormal. He is scheduled for a cardiac catheterization.

1. Is a permit required for this procedure? If so, would he be able to sign it?
2. What questions would you need to ask him when preparing him for this diagnostic test?
3. What would be the priorities of care related to this diagnostic test after the procedure is finished?