CHAPTER 2

Care of the Client with Cardiovascular Disorders

The cardiovascular system comprises the heart and blood vessels, and is responsible for the transport of oxygen and nutrients to organ systems of the body. The heart is a cone-shaped organ made up of four chambers. The right atrium receives blood from the venous system by way of the superior and inferior vena cavae. Most of the venous blood flows through the tricuspid valve and into the right ventricle during the filling phase of cardiac contraction. The remaining venous blood flows into the right ventricle during the atrial systolic or contraction phase of cardiac contraction. The blood then moves to the lungs where carbon dioxide is released and oxygen is taken on. The left side of the heart then pumps the oxygenated blood to the body. During systole the pressure exerted on the ventricle closes the mitral valve to prevent blood from flowing backward into the left atrium and opens the aortic valve to assist the ventricle to pump adequate oxygenated blood out of the heart into the aorta and to the body. Arteries and veins are types of blood vessels. *Arteries* transport oxygenated blood and *veins* transport deoxygenated blood. Figure 2.1 provides an illustration of the anatomy of the heart for reference throughout the chapter.

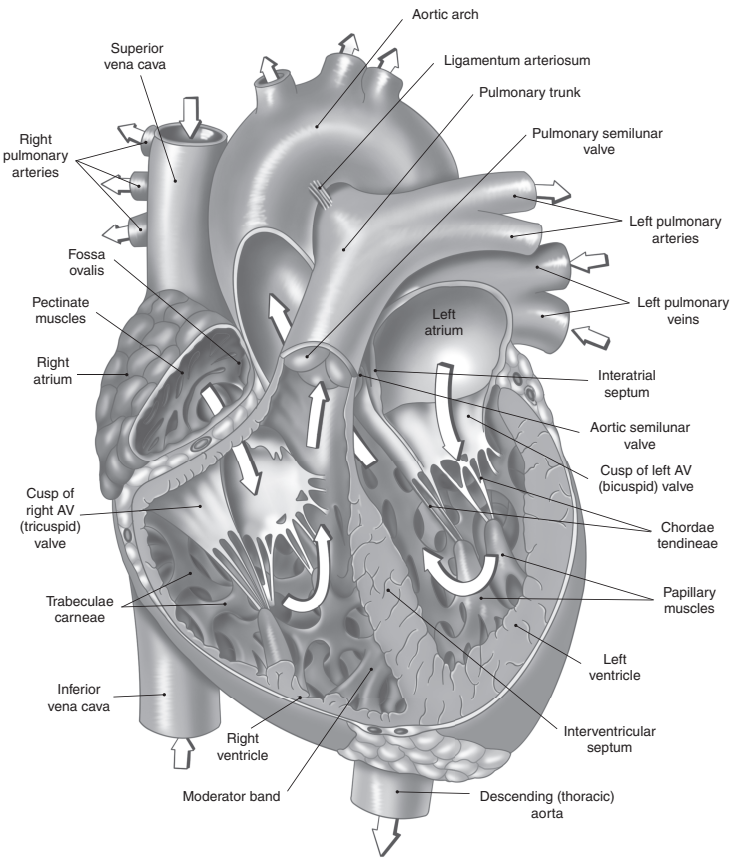

FIGURE 2.1 Anatomy of the Human Heart

In this chapter, you will discover diseases that affect the cardiovascular system, treatment of these diseases, and their effects on the client's general health status.

Hypertension

Blood pressure is the force of blood exerted on the vessel walls. *Systolic* pressure is the pressure during the contraction phase of the heart and is the top number of a blood pressure reading. *Diastolic* pressure is the pressure during the relaxation phase or filling phase of the heart and is the bottom number of a blood pressure reading. Factors that alter peripheral resistance, heart rate, and stroke volume affect the blood pressure. *Hypertension* is defined as a systolic blood pressure greater than or equal to 140 over 90 mm Hg. If the client has diabetes or kidney disease, a systolic blood pressure greater than 130 mm Hg systolic and a diastolic blood pressure of 80 mm Hg or higher is considered hypertension and should be treated. The autonomic nervous system and circulating blood volume control blood pressure. Blood pressure also directly relates to circulating hormones such as antidiuretic hormones.

Hypertension is classified as either primary or secondary. *Primary* or *essential* hypertension develops without apparent cause; *secondary* hypertension develops as the result of another illness or condition. Some examples of diseases that result in secondary hypertension are diabetes, peripheral vascular disease, renal disease, preeclampsia, coarctation of the aorta, adrenal tumors such as pheochromocytomas, brain tumors, encephalitis, and primary aldosteronism. This and other chapters of the book will discuss these diseases. Obesity and smoking also affect blood pressure. Appropriate treatment of the contributing illness improves the symptoms associated with secondary hypertension.

Malignant hypertension is an extremely elevated blood pressure that often results in a cerebral vascular accident or a myocardial infarction. Secondary hypertension occurs when another disease process causes the blood pressure to elevate above normal limits. Some examples of causes for secondary hypertension are kidney disease, diabetes, preeclampsia, and pheochromocytoma. Many medications can lead to secondary hypertension. Some examples of medications that can lead to hypertension are NSAIDS (nonstreroidal anti-inflammatory drugs), cocaine, amphetamines, bronchodilators and estrogen preparations. The client might complain of a headache, blurred vision, and dyspnea. If renal function is impaired, the client will exhibit signs of uremia. A systolic blood pressure greater than 200 mm Hg and a diastolic blood pressure greater than 150 mm Hg is life-threatening. To prevent further deterioration of the client's condition, medical personnel must implement prompt intervention.

Diagnosing the Client With Hypertension

The accuracy of a BP reading depends on the correct selection of cuff size. The bladder of the blood pressure cuff size should be sufficient to encircle the arm or thigh.

According to the American Heart Association, the bladder width should be approximately 40% of the circumference or 20% wider than the diameter of the midpoint of the extremity. A too-small blood pressure cuff yields a false high reading, whereas a too-large blood pressure cuff yields a false low reading. For accuracy, the arm being used to check the blood pressure should be held at the level of the heart. The blood pressure should be taken on at least two occasions sitting, standing and in a supine position. Diagnosis of hypertension involves conducting a comprehensive history of illness and stressors in the client's life and medications taken by the client . Laboratory studies must be completed to determine any underlying illness that might be present. Some laboratory studies indicate the presence of protein in the urine. Others studies measure serum creatinine levels, blood urea nitrogen, serum corticoids, and 17–ketosteroids in the urine. The presence of serum corticoids and 17-ketosteroids in the urine is diagnostic of Cushing's disease or increased function of the adrenal glands. A radiography study, such as an intravenous pyelography (IVP), can confirm renal disease. X-rays to determine the presence of tumors might also be ordered. An electrocardiogram (ECG) is valuable in determining the extent of cardiovascular involvement. Ultrasounds of the kidneys or the presence of adrenal tumors can also assist the physician with making a diagnosis of secondary hypertension.

Managing the Client with Hypertension

Management of hypertension includes a program of stress reduction, diet, smoking cessation, and exercise. A diet low in sodium is suggested. If the client's cholesterol level is elevated, a low fat, low cholesterol diet is ordered. The normal serum cholesterol level is 122–200 mg/dL or 3.16–6.5 mmol/L. The normal triglyceride level is 37–286 mg/dL or 0.42–3.23 mmol/L. The National Cholesterol Education Program recommends screening guidelines based on

- Total serum cholesterol and high-density lipoprotein (HDL) levels in persons that do not show signs of cardiac or peripheral vascular disease
- Total serum cholesterol and HDL levels in clients with risk factors for heart disease

A desirable high-density lipoprotein level is above 40 mg/dL, and a desirable low-density lipoprotein (LDL) level is below 100 mg/dL. A triglyceride level of 150 mg/dl is considered normal. A triglyceride level of 200 mg/dL or higher indicates that the client is at risk for cardiovascular disease. Scientists recently found that *homocysteine*, a sulfur-containing amino acid derived from dietary protein, plays a part in the development of heart disease. A serum homocysteine level greater than 15 µmol/L is considered a risk factor.

Current studies show consumption of folic acid can help to lower homocysteine levels. Foods such as meats, eggs, and canola oil are rich in monounsaturated fat. Safflower and sunflower oils are high in polyunsaturated oils. These oils are recommended for individuals at risk for coronary disease. The client is taught to avoid palm oil and coconut oil. If a change in diet does not lower the client's cholesterol level, the doctor might prescribe hyperlipidemic medications such as simvastatin (Zocor), gemfibrozil (Lopid) or ezetimibe (Zetia).

If diet, weight control, and exercise are unsuccessful in controlling the client's hypertension, the health care provider might need to treat the client with a diuretic and/or an antihypertensive medication. There are three types of diuretics. Thiazide diuretics such as Furosemide (Lasix) work by decreasing the amount of sodium, chloride and water reabsorbed in the distal tubule. These drugs are not potassium-sparing diuretics. Loop diuretics decrease sodium reabsorption in the ascending loop of Henle and do not spare potassium. The nurse should assess the client taking non-potassium sparing diuretics for signs of hypokalemia. Potassium-sparing diuretics work by inhibiting the creation of antidiuretic hormone, thereby decreasing the amount of sodium ions. Diuretics are usually prescribed to be taken in the morning on a one-time-daily regime. Taking the diuretic in the morning allows the client to sleep comfortably during the night rather than experiencing nocturia (night-time voiding).

If diuretics alone are unsuccessful in lowering the blood pressure, the physician might need to add an antihypertensive medication. Beta-adrenergic agents lower blood pressure by blocking the beta receptors. Bradycardia (a heart rate of less than 60 beats per minute)and congestive heart failure are possible complications of this type of medication. The client should be taught to check his pulse rate daily and report bradycardia to the physician. Clients with a history of asthma taking beta-adrenergic agents should be be watched for complications such as bronchospasms. Side effects include fatique, weakness, sexual dysfunction, and depression. These drugs might be prescribed in combination with a diuretic.

Calcium channel blockers such as verapamil hydrochloride (Calan) lower the blood pressure by interfering with calcium ions. This reduction in calcium ions results in vasodilation.

NOTE

Calcium channel blockers are more effective for the elderly and African American clients because they provide a better control blood pressure without many of the side effects associated with other categories of drug.

Angiotensin-converting enzyme (ACE) inhibitors are also used alone or in combination with a diuretic. ACE inhibitors work by inhibiting angiotensin I to angiotensin II, a very potent vasoconstrictor. An example of an ACE inhibitor is lisinopril (Zestril). When the client starts taking an ACE inhibitor, he should be taught to remain in bed for three to four hours because it can cause initial postural hypotension in some clients. One of the most common side effects of ACE inhibitors is a chronic cough. If the client

experiences chronic coughing he should report to the health care provider. Angioedema, a condition marked by development of edematous and itching areas of the skin or mucous membranes and visceral edema, are signs of a reaction to the medication. If the client experiences signs of angioedema, the health care provider should be notified immediately.

Angiotensin II receptor antagonists block the binding of angiotensin II while allowing angiotensin-converting enzymes to function normally. This allows vasodilation to occur. An example of an angiotensin II receptor antagonist is losartan (Cozaar). They are an excellent choice for clients that experience a hacking cough when taking ACE inhibitors.

Central alpha agonists act on the central nervous system and prevent reuptake of norepinephrine. This results in vasodilation. Two examples of central apha agonists are clonidine (Catapres) and methyldopa (Aldomet). Male clients sometimes experience impotence when taking methyldopa (Aldomet). Anemia and liver dysfunction are possible complications of this category of medication.

Vasodilators such as Nitrobid and Nitropress relax and dilate smooth muscles, thereby, causing a decrease in peripheral vascular resistance.. Alpha-adrenergic receptor agonists dilate arterioles and veins, therefore lowering the blood pressure quickly. An example of this category of drugs is prazosin (Minipress) Most clients with essential hypertension require maintenance with medication and diet for the rest of their life.

Coronary Artery Disease

Coronary artery disease (CAD) affects the arteries. When narrowing of the *coronary arteries* (the large arteries that supply the myocardium with blood) occurs, the result is *ischemia*. Narrowing of the coronary arteries is usually due to atherosclerosis.

Atherosclerosis and Arteriosclerosis

Though atherosclerosis and arteriosclerosis are related problems, they are not the same. Atherosclerosis is a *type* of arteriosclerosis involving cholesterol deposits and triglyceride deposits. *Atherosclerosis* is the overgrowth of smooth muscle cells. Narrowing of the blood vessels is the result of an overgrowth of intimal smooth muscle cells with accumulation of macrophages and T cells, formation of connective tissue in the vessels, and accumulation of lipids and cholesterol in the vessels. The narrowing causes decreased blood flow to heart and major organs. If the client has coronary artery disease stress or exercise can lead to symptoms of ischemia. *Arteriosclerosis* is the thickening and hardening of the arterial walls.

Symptoms of arteriosclerosis and atherosclerosis include intermittent claudication, decreased circulation to the extremities, changes in skin color and coolness of the extremities, headaches, dizziness and loss of memory. Factors that contribute to arteriosclerosis and atherosclerosis are age, obesity, cigarette smoking, diabetes, and familial predisposition. Treatment involves weight control with a diet low in fats and cholesterol. Stress reduction and smoking cessation also help to decrease the client's risk factors.

Conduction System of the Heart

The normal conduction system of the heart is composed of the sinoatrial (SA) node located at the junction of the right atrium and the superior vena cava. The SA node is the main pacer of the heart rate. This area contains the pacing cells that initiate the contraction of the heart. The atrioventricular (AV) node is located in the interventricular septum. The AV node receives the impulse and transmits it to the bundle of His, which extends down through the ventricular septum and merges with the Purkinje fibers in the lower portion of the ventricles. Figure 2.2 shows an anatomical drawing of the conduction system of the human heart.

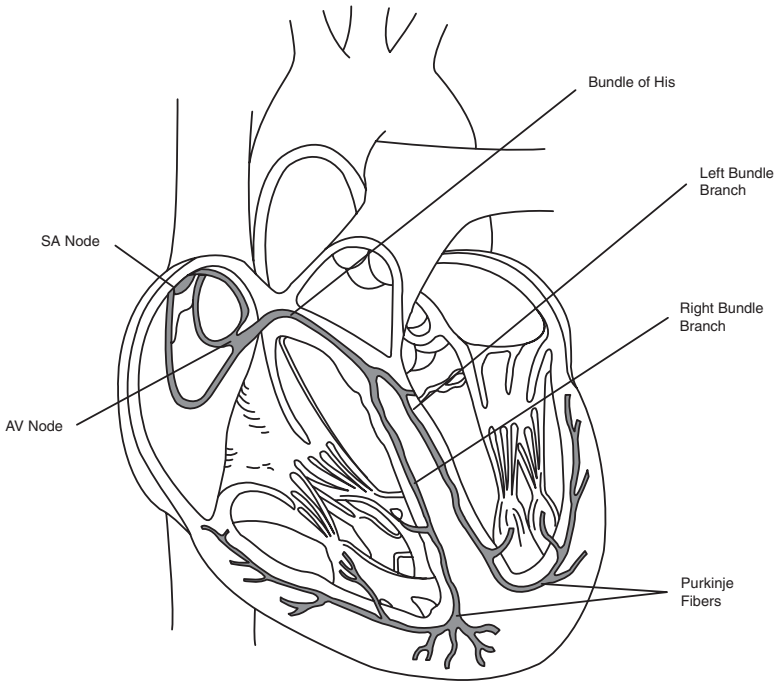

FIGURE 2.2 Electrical system of the heart.

Heart Block

Heart block can occur as the result of structural changes in the conduction system (such as myocardial infarctions, coronary artery disease, tumors and infections of the heart) or toxic effects of drugs (such as digitalis). Heart block occurs when there is a problem with the conduction system of the heart.

First-degree AV block occurs when the SA node continues to function normally, but transmission of the impulse fails. Because of the conduction dysfunction and ventricular depolarization, the heart beats regularly but the P-R interval is slowed. These clients are usually asymptomatic and all impulses eventually reach the ventricles.

Second-degree heart block is a block in which some impulses reach the ventricles but others do not.

In third-degree heart block or *complete heart block*, none of the sinus impulses reaches the ventricle. This results in erratic heart rates in which the sinus node and the

atrioventricular nodes beat independently. The result of this type of heart block can be hypotension, seizures, cerebral ischemia, or cardiac arrest. A heart block is detected by assessing an electrocardiogram.

Toxicity to Medications

Toxicity to medications such calcium chanel blockers, betablockers or digitalis can be associated with heart block. Clients taking betablockers or digoxin (Digitalis) should be taught to check their pulse rate and to return to the physician for regular evaluation of their digitalis level. Judious monitoring of the digoxin (Digitalis) blood levels is an important factor in the care of the client. The therapeutic level for digoxin (Digitalis) is 0.9–1.2 ng/mL. If the client's blood level of digoxin (Digitalis) exceeds 2.0 ng/mL, the client is considered toxic. Clients with digoxin toxicity often complain of nausea, vomiting, and seeing halos around lights. A resting pulse rate of less than 60 bpm in an adult client, less than 80 bpm in a child, and less than 100 bpm in a neonatal client should alert the nurse to the possibility of toxicity. Treatment for digitalis toxicity includes checking the potassium level because hypokalemia can contribute to digitalis toxicity. The physician often will order potassium be given IV or orally, and that the digitalis be held until serum levels return to normal. Another medication, such as Isuprel or atropine, is frequently ordered to increase the heart rate. A high fiber diet will also be ordered because constipation contributes to digitalis toxicity.

Malfunction of the Conduction System

Because a malfunction of the conduction system of the heart is the most common cause of heart block, a pacing mechanism is frequently implanted to facilitate conduction. Pacemakers can be permanent or temporary and categorized as demand or set. A *demand* pacemaker initiates an impulse if the client's heart rate falls below the prescribed beats per minute. A *set* pacemaker overrides the heart's own conduction system and delivers an impulse at the rate set by the physician. Pacemakers are frequently combined with an internal defibrillation device. Figure 2.3 shows a graph that depicts a pacemaker spike with a normal electrocardiogram.

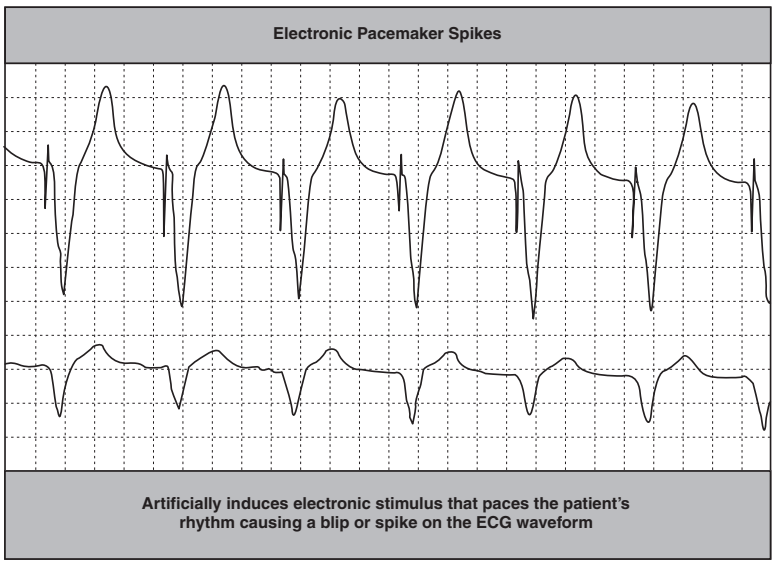

FIGURE 2.3 Indicates the pacemaker spike with a normal electrocardiogram.

Cardiac Monitoring

An electrocardiogram provides a tracing of the heart's electrical currents. Electrodes attach to the client's chest with adhesive pads and then attach to cables (*leads*) connected to the electrocardiograph machine. Leads are made up of positive and negative electrodes. The relationship between the positive and negative electrodes is responsible for the deflections seen on the ECG machine. Figure 2.4 shows the correct placement of electrodes.

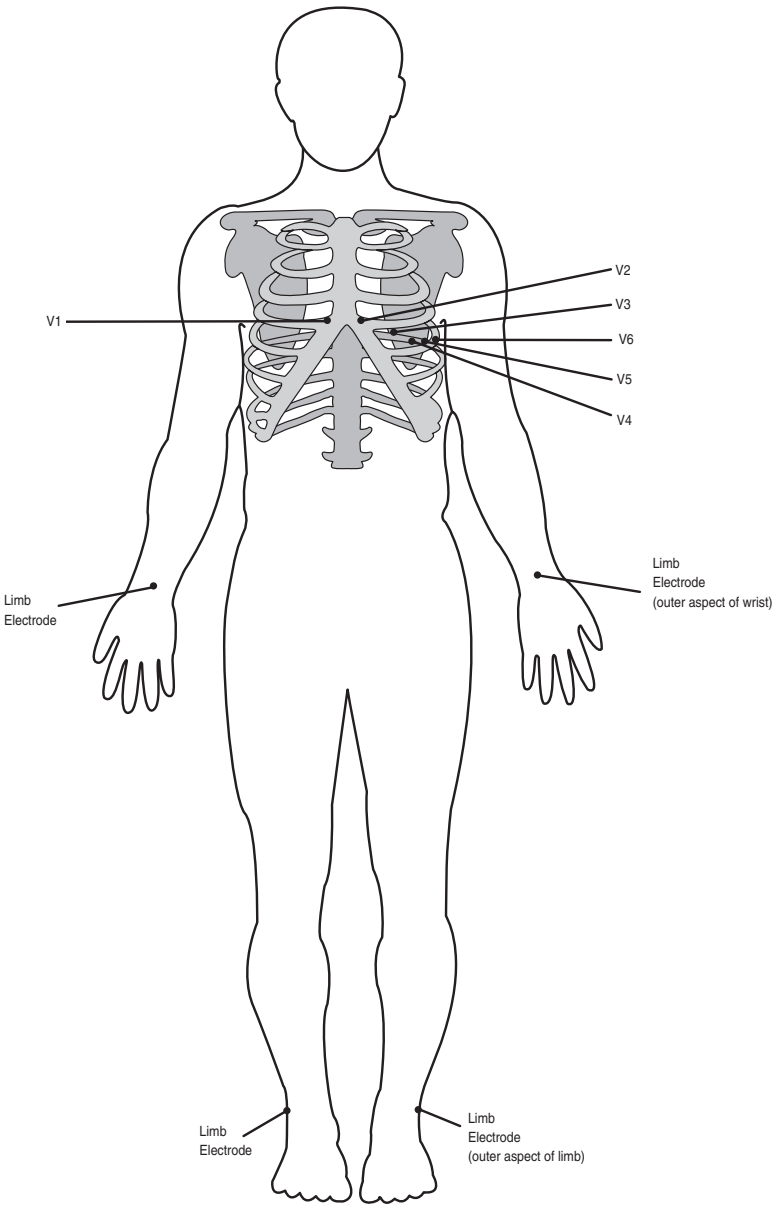

FIGURE 2.4 Twelve-lead ECG electrode placement.

The most commonly used ECG consists of 12 leads. Six leads are placed on the chest wall (V^1–V^6). These six leads provide a picture of the heart's electrical activity from a

variety of positions on the chest wall. The chest leads are placed on the horizontal axis of the chest. The limb leads are attached to the arm and legs.

The client should be taught to remain as still as possible during ECG assessment and should be positioned in a semireclined position. For continuous ECG monitoring, the use of limb leads is not recommended because limb movement causes an inaccurate reading. Continuous ECG readings are most commonly done using the MCL (modified chest lead) system, which incorporates only three leads. The negative electrode is placed just below the left mid-clavicle area and the positive electrode is placed in the V? position. The V1 position is located at the fourth intercostals position at the sternal border. V2 is placed at the fourth intercostals space at the left sternal border. V3 is located midway between V2 and V4. V5 is located at the fifth intercostals space at the anterior axillary line. V6 is located at the fifth intercostals space at the midaxillary line. The ground electrode can be placed anywhere but is usually placed under the right clavicle. For accuracy of chest lead placement, the client's chest hair should be clipped with scissors rather than shaved because shaving can abrade the skin.

Reading a ECG

Figure 2.5 shows a normal ECG reading. The P wave represents atrial depolarization. A *P-R segment* is the time required for an electrical impulse to travel from the AV node to the branches of the bundle of His and Purkinje fibers. A *P-R interval* is the time required for the atria to depolarize and the impulse to travel through the conduction system to the Purkinje fibers. It is measured from the beginning of the P wave to the end of the P-R segment. The *QRS complex* represents the contraction phase of the heart and is measured from the beginning of the Q wave or R wave to the end of the S wave. The *T wave* represents repolarization of the heart.

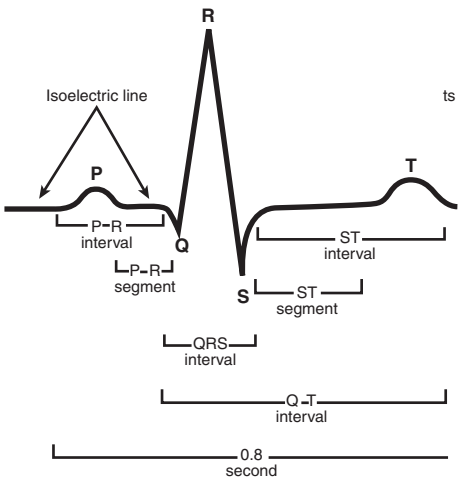

FIGURE 2.5 A normal electrocardiogram.

After you look at the ECG reading for the presence of the P wave, QRS complex, and T wave, you will want to start your evaluation of the heart rate. Measure the rate by counting the number of P-P intervals or R-R intervals on a six-second ECG strip. Timing should begin with the P wave or the QRS complex and end thirty large blocks

later. The heart rate can be determined looking at a six-second strip, count the cardiac cycles and the number of QRS complexes, and multiply by ten. This method provides an accurate rate analysis whether the rate is regular or irregular.

A normal rhythm is one that originates in the SA node, is regular, has a rate of 60–100 beats per minute, has a P wave that is consistent and is followed by a QRS complex. ECG tracing paper measures electrical impulses in duration of time. Each large block on the paper is 5 mm or 0.20 seconds and contains 25 small blocks. Each small block on the paper is 1 mm or 0.04 seconds. The normal ECG rhythm has a P-R interval of 0.12–0.20 seconds, and has a QRS complex with a duration of 0.04–0.12 seconds.

Cardiac Dysrhythmias

Cardiac dysrhythmias occur when the heart loses its regular pacing capability. They are classified according to their origin. These abnormal rhythms can be lethal or of no danger to the client's well being. *Tachydysrhythmias* are characterized by a heart rate greater than 100 bpm. If the client has coronary artery disease, blood flow might be decreased to the heart. *Bradydysrhythmias* are characterized by a heart rate less than 60 beats per minute. Dizziness and syncopy are often the only symptoms that the client notices. The client might tolerate this slow rate or bradydysrhythmias might cause the blood pressure to be subnormal, leading to shock or ischemia. Another alteration in the normal beat the client might experience is bigeminy, a condition where there are arrhythmias occurring in pairs. The pairs can be junctional, atrial, or ventricular beats. A junctional beat is one originating at the AV and bundle of HIS. An atrial dysrhythmia originates in the atria of the heart, while a ventricular dysrhythmia originates in the ventricle of the heart.

Unlike tachydysrhythmias and bradydysrhythmias, which usually originate in the atria, ventricular dysrhythmias are life-threatening and their impulse originates in the ventricles.

Ventricular Tachycardia

Ventricular tachycardia is a rapid irregular rhythm with the absence of a P wave. Usually the rate exceeds 140–180 bpm. The SA node continues to discharge independently of the ventricle. Ventricular tachycardia is often associated with valvular heart disease, heart failure, hypomagnesium, hypotension, and ventricular aneurysms. Figure 2.6 shows an ECG reading indicative of ventricular tachycardia.

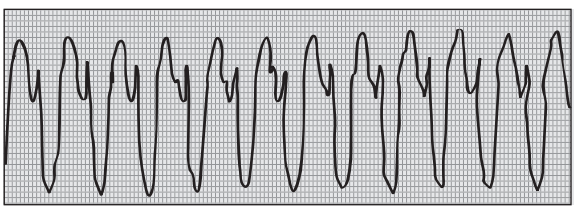

FIGURE 2.6 Evidence of ventricular tachycardia.

Ventricular tachycardia is most commonly treated with supplemental oxygen and medications. Amiodarone (Cordarone), procainamide (Pronestyl), or magnesium sulfate is given to slow the rate and stabilize the rhythm. Lidocaine has long been established for the treatment of ventricular tachycardia; however, it should not be used in an acute MI client. In addition to the rate and rhythm regulation medications, heparin is often ordered to prevent further thrombus formation. It is important to note that heparin is not given to a client receiving streptokinase.

Ventricular Fibrillation

Ventricular fibrillation (V-fib) is the primary mechanism associated with sudden cardiac arrest. This disorganized chaotic rhythm results in a lack of pumping activity of the heart. Without effective pumping, no oxygen is sent to the brain and other vital organs. If this condition is not corrected quickly, the client's heart stops beating and asystole is seen on the ECG. The client quickly becomes faint, loses consciousness, and becomes pulseless. Hypotension, or a lack of blood pressure, and abnormal heart sounds are present. Figure 2.7 shows a diagram of the chaotic rhythms typical with V-fib.

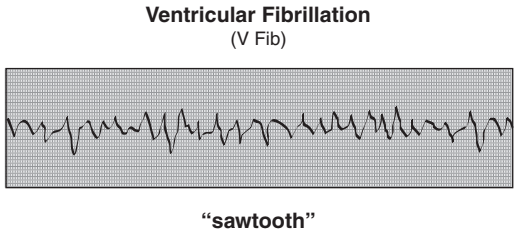

FIGURE 2.7 Ventricular fibrillation diagram.

Treatment of ventricular fibrillation is done with a defibrillator set at approximately 200 joules. Three quick, successive shocks are delivered, with the third at 360 joules. If a defibrillator is not readily available, a precordial thump can be delivered. If cardiac arrest occurs, the nurse should initiate cardiopulmonary resuscitation and be ready to administer first-line drugs such as epinephrine or vasopressin (Pitressin).

Internal Cardiac Defibrillators

An internally implanted cardioverter/defibrillator is used to treat ventricular fibrillation and other dysrhythmias. This device is usually implanted on the client's left side and is connected to the myocardium with electrical leads. If the client experiences fibrillation or ventricular tachycardia, a shock is automatically delivered to the heart and corrects the pattern. The internal defibrillator also records dysrhythmias that the client has experienced so that the physician is aware of the client's condition. The client with an internal cardiac defibrillator or permanent pacemaker should be taught to

- Wear a medic alert stating that a pacemaker/internal defibrillator is implanted. Identification will alert the healthcare worker so that alterations in care can be made.
- Take pulse for one full minute and report the rate to the physician.

- Avoid applying pressure over the pacemaker. Pressure on the defibrillator or pacemaker can interfere with the electrical leads.
- Inform the dentist of the presence of a pacemaker because electrical devices are often used in dentistry.
- Avoid having a magnetic resonance imaging (MRI) test. Magnetic resonance interferes with the electrical impulse of the implant.
- Avoid close contact with electrical appliances, electrical or gasoline engines, transmitter towers, antitheft devices, metal detectors, and welding equipment because they can interfere with conduction.
- Be careful when using microwaves. Microwaves are generally safe for use, but the client should be taught to stand approximately five feet away from the device while cooking.
- Report fever, redness, swelling, or soreness at the implantation site.
- If beeping tones are heard coming from the internal defibrillator, immediately move away from any electromagnetic source. Stand clear from other people because shock can affect anyone touching the client during defibrillation.
- Report dizziness, fainting, weakness, blackouts, or a rapid pulse rate. The client will most likely be told not to drive a car for approximately 3 months after the internal defibrillator is inserted to evaluate any dysrhythmias.
- Report persistent hiccupping because this can indicate misfiring of the pacemaker/internal defibrillator.

Cardiopulmonary Resuscitation

The American Heart Association released new guidelines for professionals and the public in November of 2005. These guidelines were printed by the American Heart Association in the *Circulation* journal in 2006 and are as follows:

- Unskilled personnel should begin chest compressions and ventilations after delivering two rescue breaths to an unresponsive victim. Lay rescuers are not taught to assess for pulse or signs of circulation for an unresponsive victim.
- Lay rescuers will not be taught to provide rescue breathing without chest compressions.
- The lone healthcare provider should alter the sequence of rescue response based on the most likely etiology of the victim's problem:
    - For sudden collapse in victims of all ages, the lone healthcare provider should telephone the emergency response number and get an AED (when readily available) and then return to the victim to begin CPR and use the AED.

  - For unresponsive victims of all ages with likely asphyxial arrest (for example, drowning), the lone healthcare provider should deliver about five cycles (about two minutes) of CPR before leaving the victim to telephone the emergency response number and get the AED. The rescuer should then return to the victim, begin the steps of CPR, and use the AED.
- After delivery of two rescue breaths, healthcare providers should attempt to feel a pulse in the unresponsive, nonbreathing victim for no more than 10 seconds. If the provider does not definitely feel a pulse within 10 seconds, the provider should begin cycles of chest compressions and ventilations.
- Healthcare providers will be taught to deliver rescue breaths without chest compressions for the victim with respiratory arrest and a perfusing rhythm (that is, pulses). Rescue breaths without chest compressions should be delivered at a rate of about 10 to 12 breaths per minute for the adult, and a rate of about 12 to 20 breaths per minute for the infant and child.
- Healthcare providers should deliver cycles of compressions and ventilations during CPR when there is no advanced airway (for example, endotracheal tube, laryngeal mask airway [LMA], or esophageal-tracheal combitube [Combitube]) in place. Once an advanced airway is in place for infant, child, or adult victims, two rescuers no longer deliver "cycles" of compressions interrupted with pauses for ventilation. Instead, the compressing rescuer should deliver 100 compressions per minute continuously, without pauses for ventilation. The two rescuers should change compressor and ventilator roles approximately every two minutes to prevent compressor fatigue and deterioration in quality and rate of chest compressions. When multiple rescuers are present, they should rotate the compressor role about every two minutes. The switch should be accomplished as quickly as possible (ideally in less than five seconds) to minimize interruptions in chest compressions.

NOTE

Refer to the AHA (American Heart Association) website for current updates.

Angina Pectoris

Angina pectoris is defined as chest pain caused by disruption of the balance and demand for oxygen by the heart. This disruption results in a lack of oxygen to the myocardium.

Several risk factors predispose the client to cardiac ischemia. These include

- Hypertension
- Hyperlipidemia
- Smoking
- Obesity
- Familial history

- Anemia
- Stress
- Diabetes

The nurse caring for the client with angina pectoris assesses the type and location of chest pain. The pain is usually located in the substernal to retrosternal area and radiates down the left arm and to the jaw or shoulder. The onset is usually precipitated by a large meal, exertion, stress, anxiety, smoking, alcohol, or drugs, and might occur immediately when the client awakens. The client's skin is usually warm and dry, but might be cool and clammy. He might complain of nausea and vomiting and gripping chest pain. Women frequently do not complain of the typical chest pain associated with angina, but may complain of fatigue and shortness of breath. An ECG often reveals S-T segment depressions and T wave inversion.; there might be S-T depressions. If the client has Prinzmetal's angina there might be an elevation in the S-T segment.

Treatment involves the application of oxygen and the administration of nitroglycerine sublingually, topically, or intravenously. The client should be taught to take one nitroglycerine tablet sublingually every five minutes, not to exceed three tablets. If the first tablet does not relieve the pain, a second can be taken. If the pain is still not relieved after taking three tablets the client should go directly to the hospital or call an ambulance. The client should be taught to replenish the supply of nitroglycerine every six months and protect the pills from light by leaving them in the brown bottle. It is important for the client to understand that light decreases the effectiveness of nitroglycerine. Nitroglycerine patches and creams should be applied to dry skin. The site should be relatively free of hair. Most resources suggest that the hair should be clipped and not shaved because shaving might abrade the skin and cause irritation. Nurses should always wear gloves when applying nitroglycerine creams or patches to prevent application of the medication to themselves. Intravenous nitroglycerine must be administered with an infusion rate controller.

Myocardial Infarction

When there is a disruption in blood supply to the myocardium, the client is considered to have had a *myocardial infarction*. Factors contributing to diminished blood flow to the heart include arteriosclerosis, emboli, thrombus, shock, and hemorrhage. If circulation is not quickly restored to the heart, the muscle becomes necrotic. Hypoxia from ischemia can lead to vasodilation. Acidosis associated with electrolyte imbalances often occurs, and the client can slip into cardiogenic shock. The most common site for a myocardial infarction is the left ventricle. Only 10% of clients report the classic symptoms of a myocardial infarction. Women often fail to report chest pain and, if they do, they might tell the nurse that the pain is beneath the shoulder or in the back. Clients with diabetes have fewer pain receptors and might report little or no pain.

The most commonly reported signs and symptoms associated with myocardial infarction include

- Substernal pain or pain over the precordium for a duration greater than 15 minutes
- Pain that is described as heavy, vise-like, and radiating down the left arm
- Pain that begins spontaneously and is not relieved by nitroglycerin or rest
- Pain that radiates to the jaw and neck
- Pain that is accompanied by shortness of breath, pallor, diaphoresis, dizziness, nausea, and vomiting
- Increased heart rate, decreased blood pressure, increased temperature, and increased respiratory rate

Diagnosis of Myocardial Infarction

The diagnosis of a myocardial infarction is made by looking at both the electrocardiogram and the cardiac profile that consist of the cardiac enzymes. The following are the most commonly used diagnostic tools for determining the type and severity of myocardial infarction:

- Electrocardiogram
- Serum enzymes and isoenzymes

Other tests that are useful in providing a complete picture of the client's condition are white blood cell count (WBC), sedimentations rate, and blood urea nitrogen (BUN).

The best serum enzymes used to diagnose myocardial infarction are creatine kinase (CKMB), troponin T and 1, CRP, and LDH. The enzyme CKMB is released when there is damage to the myocardium. The troponin T and 1 are specific to striated muscle and are often used to determine the severity of the attack. C-reactive protein (CRP) levels are used with the CKMB to determine whether the client has had an acute MI and the severity of the infarction. Lactic dehydrogenase (LDH) is a nonspecific enzyme that is elevated with any muscle trauma.

Management of a Client with Myocardial Infarction

Management of a client with myocardial infarction (MI) includes monitoring of blood pressure, oxygen levels, and pulmonary artery wedge pressures. Because the blood pressure can fall rapidly, medication such as dopamine is prescribed. Other medications are ordered to relieve pain and to vasodilate the coronary vessels—for example, morphine sulfate IV is ordered for pain. Thrombolytics, such as streptokinase, will most likely be ordered. Early diagnosis and treatment significantly improve the client's prognosis.

Clients suffering a myocardial infarction can present with dysrhythmias. Ventricular dysrhythmias, such as ventricular tachycardia or fibrillation, can lead to cardiac standstill and death if not treated quickly.

The client with an MI should be given small, frequent meals. The diet should be low in sodium, fat, and cholesterol. Adequate amounts of fluid and fiber are encouraged to prevent constipation. Stool softeners are often ordered to prevent straining during defecation. Post-MI teaching should stress the importance of a regular program of exercise, stress reduction, regular bowel elimination, and cessation of smoking. Because caffeine causes vasoconstriction, caffeine intake should be limited. The client can resume sexual activity in six weeks or when he is able to climb a flight of stairs without experiencing chest pain. Medications such as sildenafil (Viagra) are discouraged and should not be taken within 24 hours of taking a nitrite. Clients should be taught not to perform the Valsalva maneuver or bend at the waist to retrieve items from the floor. Placing items in top drawers helps to prevent increased intrathoracic pressure. The client will probably be discharged on an anticoagulant such as enoxaparin (Lovenox) or sodium warfarin (Coumadin).

NOTE

Anticoagulants such as heparin are used to decrease the potential for clotting. The nurse should check the partial thromboplastin time (PTT). The normal control level in the most common laboratory ranges is approximately 30–60 seconds. The therapeutic bleeding time should be from one and a half to two times the control. The medication should be injected in the abdomen 2" from the umbilicus using a tuberculin syringe. Do not aspirate or massage. The antidote for heparin derivatives is protamine sulfate. Anticoagulants should be stopped at least 24 hours prior to surgery and are usually restarted 12-24 hours following surgery.

NOTE

If Coumadin (sodium warfarin) is ordered, the nurse should check or prothrombin time (PT). The control level for a prothrombin time is 10–12 seconds. The therapeutic level for Coumadin should be from one and a half to two times the control. The antidote for Coumadin is vitamin K. The international normalizing ratio (INR) is done for oral anticoagulants. The therapeutic range is 2–3. If the level exceeds 7, watch for spontaneous bleeding.

Exercise Electrocardiography

An exercise electrocardiography test, also known as the stress test or exercise tolerance test, helps to determine the function of the heart during exercise. The client is instructed to eat a light meal and refrain from smoking or consuming caffeine the morning of the test. Prior to the test, the cardiologist assesses the heart using an ECG tracing and blood pressure monitor. The client then walks on the treadmill or bicycle at a steadily progressing rate of speed of 1 to 10 miles per hour and can also be adjusted from flat to inclined. She is asked to report any shortness of breath or chest pain. Abnormalities can then be assessed. The client continues the test until:

- A rapid heart rate is reached and maintained.
- Signs or symptoms of chest pain, fatigue, or extreme dyspnea, hypotension, or ventricular dyshythmias appear on the ECG.
- There are S-T segment depressions noted on the ECG.

The client remains in the unit for approximately 2 hours after the test to assure that there are no signs of hypotension or cardiac dyshythmias. Some clients due to mobility problems are not able to walk on the treadmill or ride the bicycle. Cardiac stimulants are then used to induce stress. An example of medications used is dobutamine (Dobutrex).

Echocardiography

Echocardiography is a noninvasive test used to determine the size of the ventricle, the functionality of the valves and the size of the heart. There is no special preparation for the echocardiography and this test takes only 30–60 minutes.

A transesophageal echocardiography is a more invasive method of assessing the structures of the heart. A transducer is placed into the esophagus or stomach in order to examine the posterior cardiac structures. This test requires that the client be NPO after midnight the day of the procedure and the throat be anesthetized to prevent stimulation of the gag reflex. Following the procedure, the client is checked for return of the gag reflex prior to offering food.

NOTE

The gag reflex is stimulated by placing a tongue blade on the back of the throat. Absence of the gag reflex increases the chances of aspirating liquids.

Cardiac Catheterization

Cardiac catheterization is used to detect blockages associated with myocardial infarction and dysrhythmias. Cardiac catheterization, as with any other dye procedure, requires a signed consent. This procedure can also accompany percutaneous transluminal coronary angioplasty. Prior to and following this procedure, the nurse should

- Assess for allergy to iodine or shellfish.
- Maintain the client on bed rest for approximately 8 hours with the leg straight.
- Maintain pressure on the access site for at least five minutes or until no signs of bleeding are noted. Many cardiologists use a device called an Angio-Seal to prevent bleeding at the insertion site. The device creates a mechanical seal, anchoring a collagen sponge to the site. The sponge absorbs in 60–90 days.
- Use pressure dressing and/or ice packs to control bleeding.

- Check distal pulses because diminished pulses can indicate a hematoma at the catheter insertion site and should be reported immediately.
- Force fluids to clear dye from the body.

Percutaneous Transluminal Coronary Angioplasty and Stent Placement

A percutaneous transluminal coronary angioplasty (PTCA) is a less invasive procedure than coronary artery bypass surgery. Many clients are relieved of chest pain following this procedure. Clients with noncalcified lesions, such as plaque, benefit most from a PTCA and recover relatively quickly.

During the procedure, the physician inserts a catheter while visualizing the coronary vessels. A balloon is used to push plaque into the wall of the vessel. A stent might be placed in the artery following the balloon procedure. A *stent* is a mesh tube usually made of stainless steel. This tube is inserted following an angioplasty to prevent restenosis.

When angiography indicates that the vessel is 50% or more open, the procedure is complete. An IV of heparin is administered in a continuous infusion. Nitroglycerin or sublingual nifedipine is often given to prevent spasms of the myocardium.

Coronary Artery Bypass Graft

When the client does not respond to medical management of a coronary artery occlusion and is experiencing chest pain, the physician might perform coronary artery bypass graft (CABG) surgery. The decision to perform a CABG is based on the results of the cardiac catheterization. If the client has the following symptoms, a CABG might be performed:

- Angina with greater than 50% blockage of the left anterior descending artery
- Unstable angina with two vessels severely blocked or three vessels moderately blocked
- Ischemia of the myocardium
- Has had an acute MI
- Has ischemia following an angiography or PTCA

During a coronary artery bypass a sternal incision is performed and a donor vessel is removed. A common vessel used to bypass a blockage in the coronary arteries is the saphenous vein located in the back of the leg. Other vessels, such as the mammary artery or the radial artery, can also be used to bypass the blockage. When the client is asleep, the team of surgeons goes to work harvesting the donor vessel while another team prepares to place the client on the cardiopulmonary bypass machine. The cardiopulmonary bypass machine is often used to provide oxygen to the lungs and body during the time that the heart is stopped. Blood that is heparinized and oxygenated passes through the machine and back into the client by way of the ascending aortic vessel or the femoral artery. While the client is on the bypass machine, the core body temperature is lowered to approximately 85° F. The rationale for lowering the body temperature

is that the body's oxygen needs are lowered when the body is cooled. A potassium solution is used to bathe the heart and help prevent dysrhythmias. After the heart is stopped, the surgeon anastomoses the donor vessel to bypass the blockage. When the procedure is finished, the client is warmed and transported to the intensive care unit.

The family should be instructed that the client will return to the intensive care unit with several tubes and monitors. The client will have mediastinal tubes to drain fluid from the chest cavity. The client might also have chest tubes if reinflation of the lungs was necessary. If the client bleeds and the blood is not drained from the mediastinal area, fluid accumulates around the heart and cardiac tamponade results. If this occurs, the myocardium becomes compressed and the accumulated fluid prevents the filling of the ventricles and decreases cardiac output.

During surgery, a Swan-Ganz catheter for monitoring central venous pressure—pulmonary artery wedge pressure—is inserted in the pulmonary artery. A radial arterial blood pressure monitor is inserted to measure vital changes in the client's blood pressure. An ECG monitor and oxygen saturation monitor are also used. Other tubes used to assess and stabilize the client are a nasogastric tube to decompress the stomach, an endotracheal tube to assist in ventilation, and a Foley catheter to measure hourly urinary output.

Some clients experience depression and or recurrent nightmares following coronary artery bypass graft surgery. The family should be made aware that this is a common problem and that this problem might take several months to resolve. It is important to tell both the family and the patient to notify the surgeon if these experiences occur.

Cardiac rehabilitation is recommended and includes a plan of exercise, diet, and weight reduction. The client should be taught regarding the needs to stop smoking and to moderate alcohol consumption. Drugs used to treat sexual dysfunction, such as Viagra, should not be used within 24 hours of taking nitrites such as nitroglycerine.

Congestive Heart Failure

The potential for congestive heart failure (CHF) exists after a myocardial infarction. The nurse must monitor for signs of fluid retention. Left sided congestive heart failure occurs when fluid backed into the lungs and is indicated by rales and blood-tinged sputum. Distended neck veins are also an indication as well as the client's report of needing to sleep on two or more pillows to breathe. Right-sided congestive heart failure occurs when the blood backs into the periphery causing peripheral edema, fatigue and asites. Treatment includes diuretics, inotropes, and a diet low in sodium. Other drugs might be prescribed to decrease preload and afterload. IV nitroprusside, milrinone (Primacor), or nitroglycerine nesiritide (natrecor) are often used to improve cardiac contractility. Other medications used to support cardiac function are angiotensin receptor blockers (ARBs), angiotensin-converting enzyme (ACE) inhibitors, and beta blockers. These drugs increase the force of cardiac contractions. Morphine is often given to control pain as well as to treat preload.

If the client's condition deteriorates despite the use of cardiac drugs, an intra-aortic balloon pump (IABP) might be inserted. The IABP is inserted into the aorta. A balloon

is inflated during diastole and deflates just before systole, reducing the afterload. This procedure improves perfusion to the heart, brain, and lungs and decreases perfusion to the kidneys and lower extremities.

With use of the IABP, perfusion to the lower extremities and the kidneys could be impeded during inflation of the pump, so assessment of pulses distal to the pump insertion site and assessment of urinary output is essential.

Other management of CHF includes monitoring O_2 saturation, pulmonary artery wedge pressure (PAWP) with an attempt to maintain PAWP between 15–20 mm/hg. Central venous pressure (CVP) monitoring and frequent checking of vital signs is essential nursing care for the client with CHF.

Cardiogenic Shock

There are three types of shock: cardiogenic shock, hypovolemic shock, and vasogenic or neurogenic shock. *Cardiogenic shock* occurs when the heart fails to pump enough blood to perfuse the tissues adequately. This type of shock might be due to a myocardial infarction, congestive heart failure, pericarditis, cardiac tamponade (fluid around the heart that constricts the heart muscle), severe vascular disease, or rupture of an abdominal aortic aneurysm. Hypovolemic shock occurs when there is insufficient blood flow to maintain blood pressure. This results in decreased oxygenation to vital organs. Vasogenic or neurogenic shock occurs when there is trauma to the brain or spinal cord. This results in shock secondary to the nervous systems inability to maintain vasoconstriction. Chapter 10, "Care of the Client with Neurological Disorders," discussses this type of shock in detail. In cardiogenic shock, there is necrosis of more than 40% of the left ventricle. Most of the clients experiencing cardiogenic shock complain of chest pain. Other symptoms include

- Hypotension
- Tachycardia
- Tachypnea
- Frothy, pink-tinged sputum
- Restlessness
- Orthopnea
- Oliguria

The mortality rate of cardiogenic shock is extremely high if it is not detected early. Treatment includes oxygen therapy. The physician will order a pain reliever such as morphine sulfate. Diuretics, nitroglycerin, and other medications to reduce the preload are also parts of the treatment. In extreme situations, an intra-aortic balloon pump might be used to decrease the workload of the heart.

Aneurysms

An *aneurysm* is ballooning of an artery as illustrated in Figure 2.8. The greatest risk for these clients is rupture and hemorrhage. Aneurysms can occur in any artery in the body and might be the result of congenital malformations, arteriosclerosis, or secondary to hypertension. There are several types of aneurysms:

- **Fusiform**—Affects the entire circumference of the artery)
- **Saccular**—An outpouching affecting only one portion of the artery
- **Dissecting**—Bleeding into the wall of the vessel

The client with an abdominal aortic aneurysm will frequently complain of feeling "my heart beating in my abdomen" or low back pain. Any such complaint should be further evaluated. On auscultation of the abdomen, a bruit could be heard. Diagnosis can be made by ultrasound, computer tomography, arteriogram, or abdominal x-rays. If the aneurysm is found to be 5 centimeters or more, surgery might be scheduled. During surgery, the aorta is clamped above and below and a donor vessel is anastamosed in place. When the client returns from surgery, pulses distal to the site should be assessed. Because the blood supply is stopped to the kidneys and lower extremities during renal function should be evaluated along with pedal pulses. Use of endovascular stints is now being used to relieve pressure on the aneurysm and reinforce the weakened vessel. The stints are threaded through an incision in the femoral artery. Post-operative care is much the same as that of the client that has undergone a cardiac catheterization.

CAUTION

Do not palpate the mass because pressure on the weakened vessel can lead to rupture and hemorage.

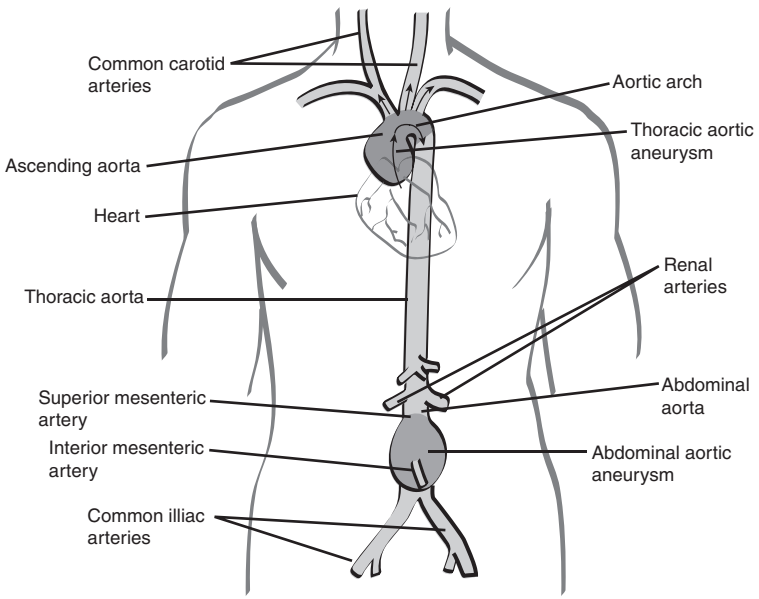

FIGURE 2.8 Abdominal aortic aneurysm.

Inflammatory Diseases of the Heart

Inflammatory and infectious diseases of the heart often are a result of systemic infections that affect the heart. Inflammation and infection might involve the endocardium, pericardium, valves, or the entire heart.

Infective Endocarditis

Infective endocarditis, also known as *bacterial endocarditis*, is usually the result of a bacterial infections, collagen diseases, or cancer metastasis. As a result, the heart is damaged and signs of cardiac decompensation results. The client commonly complains of shortness of breath, fatigue, and chest pain. On assessment, the nurse might note distended neck veins a friction rub, or a cardiac murmur.

Treatment involves treating the underlying cause with antibiotics, anti-inflammatory drugs, and oxygen therapy. Bed rest is recommended until symptoms subside. If the valve is severely damaged by infection, a valve replacement might have to be performed. Replacement valves are xenograft (bovine [cow] or, procine [pig]), cadaver, or mechanical. If the client elects to have a mechanical valve replacement, he will have to take anticoagulants for life. Following surgery, the nurse must be alert for signs of complications. These include decreased cardiac output or heart failure, infection, and bleeding. The physician often will prescribe digoxin, anticoagulants, cortisone, and antibiotics postoperatively.

Pericarditis

Pericarditis is an inflammatory condition of the pericardium, which is the membrane sac around the heart. Symptoms include chest pain, difficulty breathing, fever, and orthopnea. Clients with chronic constrictive pericarditis show signs of right-sided congestive heart failure. During auscultation, the nurse will likely note a pericardial friction rub. Laboratory findings might show an elevated white cell count. ECG changes consist of an S-T segment and T wave elevation. The echocardiogram often shows pericardial effusion.

Treatment includes use of nonsteroidal anti-inflammatory drugs to relieve pain. The nurse should monitor the client for signs of pericardial effusion and cardiac tamponade that include jugular vein distention, *paradoxical pulses* (systolic blood pressure higher on expiration than on inspiration), decreased cardiac output, muffled heart sounds. If fluid accumulates in an amount that causes cardiac constriction, the physician might decide to perform a pericardiocentesis to relieve the pressure around the heart. Using an echocardiogram or fluoroscopic monitor, the physician inserts a large-bore needle into the pericardial sac. After the procedure, the nurse should monitor the client's vital signs and heart sounds. In severe cases, the pericardium might be removed.

Peripheral Vascular Disease

The term *peripheral vascular disease* (PVD) refers to a group of diseases affecting both arteries and veins. Peripheral arterial disease, the most common type of PVD, often results in amputations, kidney disease, and ulcerations of the extremities.

Signs of PVD include a decrease in pulse rate and strength, coldness of the extremity, intermittent claudication (burning and leg cramps on ambulation), and swelling of the extremity.

Treatment is aimed at restoring blood flow to the extremity. Treatment includes a sympathectomy to sever the sympathetic ganglia, thereby resulting in vasodilation, vasodilating drugs, or femoropopliteal bypass graft. Stints can also be used to maintain an open vessel. If circulation to the extremity is not restored, an amputation might be required.

Femoral Popliteal Bypass Graft

When blood flow to the lower legs is interrupted, the physician might elect to perform to bypass the blockage in the vessel. Grafts can be made of synthetic materials such as polytetrafluoroethylene, Gore-Tex, and Dacron. Donor vessels can also be used.

Preoperatively, the nurse should assess renal function and the extremity for pulses, swelling, color, and temperature. If a Doppler is used to obtain pulses, it should be documented. Dye studies might also be ordered prior to the surgical procedure to determine the extent of the disease. The nurse should assess the client's potential complications associated with dye procedures such as allergies to iodine.

During the graft procedure, the doctor removes the donor vessel and bypasses the block vessel. Following the procedure, the nurse should monitor for signs of graft rejection. These include redness at the site and signs of decreased oxygenation to the extremity. Other nursing care includes

- Assessing color, temperature, and pulses
- Assessing for pain and administering medication as ordered
- Monitoring blood pressure
- Instructing the client to keep the affected extremity straight and not to cross the legs at the knee
- Assessing the incision site

At discharge, the client should be taught to avoid sitting at a 90° angle or crossing the legs, and to take anticoagulants and vasodilating drugs as ordered. He should also be taught to report signs of decreased oxygenation to the extremity. If graft occlusion does occur, a thrombectomy, tissue plasminogen activator, or revision of the graft might be required.

Varicose Veins / Thrombophlebitis

Varicose veins occur when the valves that serve to push blood back to the heart become weak and collapse. This allows blood to pool in the vein. The stagnant blood often clots and occlusion of the vessel occurs. If a clot breaks loose, it can travel to the heart or lungs resulting in a pulmonary emboli.

Thrombophlebitis occurs when a vein becomes inflamed and a clot forms. Most thrombophlebitis occurs in the lower extremities, with the saphenous vein being the most commonly affected vein. *Homan's sign* is an assessment tool used for many years by healthcare workers to detect deep vein thrombi. It is considered positive if the client complains of pain on dorsiflexion of the foot. Homan's sign should not be performed routinely because it can cause a clot to be dislodged and lead to a pulmonary emboli. If a diagnosis of thrombophlebitis is made, the client should be placed on bed rest with warm, moist compresses to the leg. An anticoagulant such as enoxaparin, heparin, or sodium warfarin is ordered, and the client is monitored for complications such as cellulitis. If cellulitis is present, antibiotics are ordered.

Antithrombolitic stockings or compression devices are ordered to prevent venous stasis. When antithrombolitic stockings are applied, the client should be in bed for a minimum of 30 minutes prior to applying the stockings. The circumference and length of the extremity should be measured to prevent rolling down of the stocking and a tourniquet effect.

Raynaud's Phenomenon

Raynaud's phenomenon occurs when there are vascular vasospasms brought on by exposure to cold. Raynaud's is more common in women and has been linked to decreasing estrogen levels. The most commonly affected areas are the hands, nose, and ears. Management includes preventing exposure, stopping smoking, and using vasodilators. The client should be encouraged to wear mittens when outside in cold weather.

Buerger's Disease

Buerger's disease (thromboangiitis obliterans) results when spasms of the arteries and veins occur primarily in the lower extremities. These spasms result in blood clot formations and eventually destruction of the vessels. Symptoms associated with Buerger's disease include pallor of the extremities progressing to cyanosis, pain, and paresthesia. As time progresses, trophic changes occur in the extremities. Management of the client with Buerger's disease involves the use of Buerger-Allen exercises, vasodilators, and oxygenation. The client should be encouraged to stop smoking.

Case Study

A 77-year-old male reports to the doctor with complaints of shortness of breath. On examination, the doctor finds crackles in the base of the lungs, a blood pressure of 190/96, slight tachycardia, and a gain

of 10 pounds since the client's last check-up. The doctor has prescribed medications to control congestive heart failure. Total cholesterol 240 mg/dL, sodium 160 mEq/L, and potassium 3.6 mEq/L.

1. Are the client's symptoms consistent with right-sided or left-sided congestive heart failure?

2. What medications should the nurse expect the doctor to prescribe?

3. How does the client's blood pressure affect the client's cardiac function?

4. What is the correlation between the weight gain and the congestive heart failure?

5. If the client's congestive heart failure is not treated effectively, what will be the result?

6. What dietary management should be implemented for this client?

Answers to Case Study

1. The client's symptoms are consistent with both right-sided and left-sided congestive heart failure. In left-sided congestive heart failure, fluid backs up into the lungs. In right-sided congestive heart failure, fluid backs up into the extremities. This client has weight gain, shortness of breath, and crackles heard on auscultation.
2. Treatment of congestive heart failure is threefold. The diet should be low in sodium. Medications include diuretics such as furosemide (Lasix), milrinone (Primacor), or nesiritide (Natrecor) to increase cardiac output, and pain management with morphine.
3. The client's blood pressure is elevated. The peripheral resistance increases the workload on the heart. This further compromises the cardiac condition and leads to worsening congestive heart failure.
4. The weight gain is a sign of right-sided congestive heart failure.
5. If the client's congestive heart failure is not treated, the client's lungs will fill with fluid. Fluid in the lungs prevents oxygenation to the heart and brain. The heart failure will worsen and lead to death.
6. The dietary management is low sodium, low fat, and low cholesterol.

Key Concepts

This chapter discussed the most common types of cardiovascular problems. The key concepts will help the nursing graduate on the NCLEX by focusing on the most commonly used key terms, diagnostic exams, and pharmacological agents used to treat these problems. This section is covered on the NCLEX in the area of physiological integrity.

Key Terms

- Aneurysms
- Angina pectoris
- Angioplasty
- Atherosclerosis
- Blood pressure
- Buerger's disease
- Cardiac catheterization
- Cardiac tamponade
- Cardiopulmonary resuscitation

- Cholesterol
- Conduction system of the heart
- Congestive heart failure
- Coronary artery bypass graft
- Defibrillation
- Diastole
- Electrocardiogram
- Heart block
- Hypertension
- Implantable cardioverter
- Myocardial infarction
- Pacemaker
- Raynaud's phenomenon
- Systole
- Thrombophlebitis
- Varicose veins
- Ventricular fibrillation
- Ventricular tachycardia

Diagnostics

The exam reviewer should be knowledgeable of the preparation and care of clients receiving exams to diagnose cardiovascular problems. While reviewing these diagnostic exams, the exam reviewer should be alert for information that would be an important part of nursing care for these clients. The pertinent labs and exams are as follows:

- Cardiac catheterization
- Cardiac profile
- Central venous pressure monitoring
- Chest x-ray
- Clotting studies
- Complete blood count
- Doppler studies
- Dye studies for cardiac functions

- Echocardiogram
- Electrophysiologic studies
- Exercise Tolerance Test
- Fluoroscopy
- MRI
- Oxygen saturation levels
- Serum cholesterol and triglycerides
- Serum electrolytes
- Thallium scans
- Ultrasonography
- Vital signs

Pharmacological Agents Used in the Treatment of Clients with Cardiovascular Disorders

An integral part of care to clients with cardiovascular disorders is pharmacological intervention. These medications provide an improvement or cure of the clients' cardiac problems. The nursing exam reviewer needs to focus on the drugs in Table 2.1. Included in this table are the most common side and adverse effects and pertinent nursing care.

TABLE 2.1 Pharmacologic Agents Used in the Treatment of Clients with Cardiovascular Disorders

Drug	Action	Side Effect	Nursing Care
Thiazide Diuretics Examples of this category of drugs are: Chlorothiazide (Diuril) and Hydrochlorothiazide (Esidrix, HCTZ)	This category of drugs increase excretion of water and sodium by inhibiting resorption in the early distal tubule. They are used for hypertension, edema in congestive heart failure, intraocular pressure in glaucoma.	Electrolyte imbalances, dehydration, can lead to increases in urea and gout.	Check potassium levels and teach the client to increase the consumption of potassium rich foods. Care should be taken when administering diuretics to the elderly. The client should be taught to take the medication in the morning to prevent nocturia.

(continues)

TABLE 2.1 *Continued*

Drug	Action	Side Effect	Nursing Care
Loop Diuretics An example of this type of drug is Furosemide (Lasix)	Loop diuretcs inhibit resorption of sodium and chloride in the Loop of Henle.	same	same
Osmotic Diuretics Examples of this type of drug are: mannitol (Mannitol, Osmitrol, Resectisol), urea	Osmotic diuretics increase the osmotic pressure of glomerular filtrate, so decreasing absorption of sodium.	same	same
Potassium Sparing Diuretics Examples of this type of drug are: spironolactone (Aldactone), amiloride, (Midamore)triamterene (Dyrenium)	Acts on the distal tubule to inhibit reabsorption of sodium, chloride, and increase potassium retention. This drug is used for hypertension and for cushings disease.	Can cause nausea and vomiting, can lead to electrolyte imbalances such as hyperkalemia and hyponatremia. Can lead to liver and blood dyscrasias.	Because this drug category is potassium sparing there is no need to increase potassium in the diet. Teach the client to take the drug with food to decrease gastrointestinal upset. Teach the client to avoid prolonged exposure to the sunlight, photosensitivity may occur. This drug category can turn urine blue.
Beta Adrenergic Blockers Examples of this category of drugs are: Propanolol (Inderal), metopolol (Lopressor), nadolol (Corgard)	Used to treat hypertension, ventricular dysrhythmias and angina pectoris. Nonselective blockers produce a fall in blood pressure with reflex tachycardia or bradycaria through a mixture of B-blocking effects. Selective B-blockers compete for stimulation of B-receptors in cardiac smooth muscles.	Orthostatic hypotension, bradycardia, diarrhea, nausea and vomiting.	Teach the client to rise slowly. Should be used with caution in the elderly. Can lead to congestive heart failure so the client should be taught to report signs of edema. Should be used with caution in the client with diabetes, pregnancy or asthma.

(continues)

TABLE 2.1 *Continued*

Drug	Action	Side Effect	Nursing Care
Calcium Channel Blockers Examples of this type of drug are: Nifedipine (Procardia, Adalat). Verapamil (Calan, Isoptin)	This category of drugs is used to treat hypertension and dysrhythmias, unstable angina, and stable angina. They produce calcium ion influx across the cell membrane in cardiac and vascular smooth muscle. They dilate coronary arteries, slow the SA and AV nodes and dilate peripheral arteries.	The most common side effects are dysthythmias and edema. The client might experience a headache, fatigue, drowsiness or facial flushing. These drugs should not be used in clients with 2nd and 3rd degree heart block, or cardiogenic shock since they can worsen symptoms. Caution should be taken when treating the client with congestive heart failure with this category of drugs.	Teach the client to check his/her pulse, and to report signs of edema such as shortness of breath and edema.
Angiotensin-Converting Enzyme Inhibitors Examples of this type of drug are: captopril (Capoten), lisinopril (Zestril)	This type of drugs act by selectively suppressing rennin-angiotensin I to angiotensin II. They dilate the arteries and veins.	The most common side effects are hypotension. These drugs can cause a cough, angioedema. The nurse should check creatinine levels and electrolytes to ensure that the client is not experiencing hyperkalemia.	The client should be taught to remain at rest for approximately 30 minutes after taking the first dose to prevent orthostatic hypotension. The client should be taught to report signs of renal failure.
Central Alpha Agonists (also known as Central Acting Adrenergics) Examples of this type of drug are: Clinidine hcl (Catapress), methylodopa (Aldomet)	This type of drug acts by inhibiting the sympathetic vasomotor center in the central nervous system. These drugs are used to treat hypertension.	Can lead to hypotension, bradycardia and reduce cardiac output. Assess blood studies such as neutrophils, platelets and renal function. Can cause dry mouth. Can cause allergic reactions: rash, fever, pruritis, urticaria.	Aldomet can cause impotence and turn the urine dark brown when it is exposed to sunlight. Also can cause photosensitivity. Administer this category of drugs prior to meals.

(continues)

TABLE 2.1 *Continued*

Drug	Action	Side Effect	Nursing Care
Vasodilators An example of this type of drug is Hydralazine (Apresoline)	This type of drug is used to treat hypertension and congestive heart failure.	Can lead to nasal congestion, muscle cramps, cardiac palpitations, headaches, dizziness, nausea, vomiting, anorexia, diarrhea, or constipation. Can cause a rash or pruritus. Can lead to bone marrow suppression. This drug category is contraindicated in the client with coronary artery disease and rheumatic fever.	Teach the client to take with food to decrease gastrointestinal upset. Notify the health care provider if they experience fever, severe fatigue or muscle or joint pain. Rise slowly to prevent orthostatic hypotension. Notify the health care provider if the client is pregnant.
Alpha-receptor blockers An example of this type of drug is Doxazosin (Cardura)	Causes pheripheral blood vessels to dilate. Lowers peripheral resistance, reduces blood pressure. Also used to increase urinary outflow in the client with prostate disease.	Can lead to dizziness, headaches, drowsiness, vertigo, weakness. This type of drug can also cause nausea, vomiting and abdominal pain. If the client is allergic to quinazolines there might be a cross allergic reaction. Use with caution in the pregnant client.	Take the first dose at bedtime to prevent ortostatic hypotention.
Angiotensin Receptor Blockers Examples of this type of drugs are: Valsartan (Diovan), Losartan (Cozaar), Candesartan (Atacand), Telmisartan (Micardis)	Blocks the vasoconstrictor and aldosterone-sereting effects of angiotensin II, blocks the binding of angiotensin II to the AT1 receptor found in tissue. Used to treat hypertension.	Can lead to dizziness, insomnia, anxiety, diarrhea, dyspepsia, anorexia and vomiting. Can cause myalgia. Can cause a cough, but this is less common in this category of drugs than in the ACE drugs. Increases digoxin levels. The nurse should check the creatinine levels for renal function.	Teach the client to notify the health care provider if the he/she develops mouth sores, fever, or edema.

(continues)

TABLE 2.1 *Continued*

Drug	Action	Side Effect	Nursing Care
Antidyshythmics Examples of this type of drug are: Quinidine sulfate (Quinadine), Procainamide hydrochloride (Pronestyl), Lidocaine (Xylocaine), Amiodarone hydrochloride (Cordarone), Atropine sulfate, Magnesium sulfate, Digoxin (Lanoxin)	These drugs are used to treat atrial fibrillation, Premature atrial tachycardia, ventricular tachycardia, and atrial flutter.	Can cause headaches, dizziness, confusion, psychosis, tinnitus, blurred vision, hearing loss, disturbed color vision. Nausea, vomiting, diarrhea and anorexia have been reported. Bone marrow suppression can occur. Quinidine can interact with other drugs such as digoxin (Digitalis) and anticoagulants such as sodium warfarin (Coumadin). Quinidine can prolong Q-T intervals. This drug can also cause Torsades de pointes (a very rapid ventricular tachycardia characterized by a gradually changing QRS complex). Lidocaine should be administered in a glass bottle with an infusion pump. Amiodarone HCL (Cordarone) can lead to pulmonary fibrosis. Atropine can lead to tachycardia. Magnesium sulfate can lead to hypermagnesemia. Digoxin can lead to bradycardia.	Monitor heart rate and rhythm. Teach the client taking anti-dyshythmics to: report hearing difficulty, tell the doctor if she could be pregnant, report visual disturbances and renal disease. The client taking *digoxin* should be taught to take the pulse for one full minute prior to taking the medication. If the pulse rate is below 60 in the adult, 80 in the child or 100 in the neonate the dose should be held and the health care provider notified. Signs of toxicity to digoxin are bradycardia, halos around lights and nausea. The therapeutic level of *digoxin* is .5-2 ng/ml.

(continues)

TABLE 2.1 *Continued*

Drug	Action	Side Effect	Nursing Care
Anticoagulants Examples of anticoagulants are: Warfarin sodium (Coumadin), Heparin, Enoxaparin (Lovenox)	Used to treat clients with thrombosis Warfarin sodium decreases vitamin K absorption thereby prolonging the bleeding time. Heparin and the derivatives of heparin prolong the bleeding time by interfering with the clotting chain.	Hemmorage, agranulocytosis, leucopenia, eosinophilia and thrombocytopenia. These drugs interact with salicylates (aspirin), steroids, and NSAIDS (non-steroidal anti-inflammatory drugs). Blood studies such as partial prothrombin time (PTT), protime (PT should be done periodically during the course of treatment. The client should report a rash, fever, or urticaria. The antidote for coumadin is vitamin K and the antidote for heparin is protamine sulfate.	Teach the client to report to the dentist that he is taking an anticoagulant prior to any dental work. Watch for bleeding during flossing, toothbrushing, shaving, and so on. Teach the client the correct method of taking the drug. Heparin and heparin derivatives should be given in the abdomen approximately two inches from umbilicus. The client should not aspirate after the injection or massage the area. Teach the client regarding signs of prolonged bleeding times. If the client is taking coumadin he should be taught to limit the intake of dark green leafy foods such as turnip greens. Other example of foods to limit are cabbage, rhubarb, and cauliflower because these foods contain high amounts of vitamin k. The client should report to the doctor the intake of herbals, vitamin E, or green tea since these substances prolong bleeding times and can prolong bleeding times. Note: enoxaparin (Lovenox) doses are based on weight.

(continues)

TABLE 2.1 *Continued*

Drug	Action	Side Effect	Nursing Care
Thrombolytics Examples of thrombolytics are streptokinase (Streptase), t-PA (Tissue Plasminogen Activator), abbokinase (Urokinase)	These drugs are used to destroy a clot. They are used to treat coronary thrombus, acute ischemia associated with a cerebro vascular accident, or deep vein thrombus.	Clients with a history of streptococcal infections may not respond to treatment with streptokinase since antibodies are present. The nurse should check the bleeding times.	Instruct the client to report signs of bleeding. A drug history should check for previous use of streptokinase since many physicians do not recommend that this drug be repeated only every two years. (This might be a life long restriction.)

Apply Your Knowledge

The nurse reviewing for the licensure exam must be able to apple knowledge to meet client needs. Utilization of information found in this chapter will help the graduate to answer questions found on the NCLEX.

Exam Questions

1. The client with hypertension has an order for furosemide. Which lab value must be evaluated during the course of treatment with this medication?

   A. Phosphorus

   B. Potassium

   C. Calcium

   D. Magnesium

2. The client is admitted with a diagnosis of heart block. The nurse is aware that the pacemaker of the heart is the:

   A. AV node

   B. Purkinje fibers

   C. SA node

   D. Bundle of His

3. The client is being treated with nitroprusside (Nitropress). The nurse is aware that this medication:
    A. Should be protected from light
    B. Is a non–potassium-sparing diuretic
    C. Causes vasoconstriction
    D. Decreases circulation to the extremities

4. The client being treated with lisinopril (Zestril) develops a hacking cough. The nurse should tell the client to:
    A. Take the medication at night to control the problem.
    B. Take cough medication to control the problem
    C. Stop the medication
    D. Report the problem to the doctor

5. The elderly client taking digitalis develops constipation. The nurse is aware that constipation in the client taking digitalis might:
    A. Develop an elevated digitalis level
    B. Have a decrease in the digitalis levels
    C. Have alterations in sodium levels
    D. Develop tachycardia

6. The client is suspected of having had a myocardium infarction. Which diagnostic finding is most significant?
    A. LDH
    B. Troponin
    C. Creatinine
    D. AST

7. The client with an internally implanted defibrillator should be taught:
    A. Avoid driving a car
    B. Avoid eating food cooked in a microwave
    C. Refrain from using a cellular phone
    D. Report swelling at the site

8. The client is scheduled for a cardiac catheterization. Following the procedure, the nurse should:
    A. Assess for allergy to iodine
    B. Check pulses proximal to the site
    C. Assess the urinary output
    D. Check to make sure that the client has a consent form signed

9. The client with Buerger's disease complains of pain in the lower extremities. The nurse is aware that Burger's disease is also called:
    A. Pheochromocytoma
    B. Intermittent claudication
    C. Kawasaki disease
    D. Thromboangiitis obliterans

10. The client with an abdominal aneurysm frequently complains of:
    A. A headache
    B. Shortness of breath only during sleep
    C. Lower back pain
    D. Difficulty voiding

Answers to Exam Questions

1. Answer B is correct. The client taking furosemide is at risk for developing hypokalemia (decreased potassium) because this drug is a non–potassium-sparing diuretic. Answers A, C, and D are incorrect because phosphorus, calcium, and magnesium levels are not directly affected by Lasix. These levels should be checked, but the lab value that is most significant for the nurse to check is the potassium. Alteration in the potassium can lead to cardiac conductions problems.
2. Answer C is correct. The pacemaker of the heart is the SA node. The impulse moves from the SA node to the AV node on to the right and left bundle branches and finally to the Purkinje fibers. This makes answers A, B, and D incorrect.
3. Answer A is correct. Nitroglycerine preparations should be protected from light because light decreases the effectiveness of this category of medication. Answer B is incorrect because Nitropress is not a diuretic. Answer C is incorrect because Nitropress is a vasodilator not a vasoconstrictor. Answer D is incorrect because nitroglycerine does not decrease circulation to the extremities.
4. Answer D is correct. A hacking cough is a common side effect and should be reported to the doctor. The client should not be told to half the dose since this can

result in an elevated blood pressure, so answer A is incorrect. Answer B is incorrect because taking a cough medication will mask the symptom of the allergy. Answer C is incorrect because although the client stops taking the medication, this answer states that the client can report the finding to the doctor at the time of the scheduled visit. He should report this finding immediately.

5. Answer A is correct. The client taking digitalis should avoid constipation because constipation can lead to digitalis toxicity. Answer B is incorrect because constipation will not lead to a decrease in the digitalis levels. Answer C is incorrect because constipation does not result in alterations in the sodium level. Answer D is incorrect because digitalis toxicity will result in brachycardia, not tachycardia.
6. Answer B is correct. The best diagnostic tool for confirming that the client has experienced a myocardial infarction is the troponin level. Another lab value that is associated with a myocardial infarction is the CKMB. A is incorrect because the LDH is also elevated in clients with muscle trauma not associated with an MI. C is incorrect because the creatinine level indicates renal function. D is incorrect because the AST level is elevated with gallbladder disease as well as muscle inflammation.
7. Answer D is correct. The client with an implantable defibrillator should report redness, pain, and swelling at the site of the implant. Answer A, B, and C are incorrect because the client can drive a car, eat food cooked in a microwave, and can use a cellular phone. The client probably will be told to wait three months to drive a car. He should put his food in the microwave and step five feet away from the microwave during cooking. A cellular phone can be used, but should be held in the right hand.
8. Answer C is correct. The dye used in the procedure can cause a decrease in renal function. The client's renal function should be assessed and changes reported to the doctor immediately. Answer A is incorrect because the client's allergies should be checked prior to the procedure not after the procedure. The femoral artery is commonly used as the site for a catheterization. Answer B is incorrect because the pulses should be checked distal to the site. Answer D is incorrect because the permit should be signed prior to the procedure.
9. Answer D is correct. The other name for Buerger's disease is thromboangiitis obliterans. Answer A is incorrect because pheochromocytoma is an adrenal tumor. Answer B is incorrect because intermittent claudication is pain in an extremity when walking. Answer C is incorrect because Kawasaki disease is an acute vasculitis that can result in an aneurysm in the thoracic area.
10. Answer C is correct. Clients with abdominal aortic aneurysms often complain of nausea, lower back pain, and feeling their heart beat in the abdomen. Answer A is incorrect because a headache is a symptom of a cerebral aneurysm. Answer B is incorrect because although the client with an abdominal aneurysm might have shortness of breath, this symptom is not particular to during sleep. Answer D is incorrect because difficulty voiding is not associated with an abdominal aneurysm.

Suggested Reading and Resources

- Ignataviicus, Donna D., Workman, Linda, *Medical-Surgical Nursing*. Philadelphia: W.B. Saunders Company, 2005.
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