chapter 39

Cardiotonics and Miscellaneous Inotropic Drugs

Key Terms

atrial fibrillation
cardiac glycosides
cardiac output
digitalis glycosides
digitalis toxicity
digitalization
heart failure
hypokalemia
left ventricular dysfunction
neurohormonal activity
positive inotropic action
right ventricular failure

Chapter Objectives

On completion of this chapter, the student will:

- Discuss heart failure in relationship to left ventricular failure, right ventricular failure, neurohormonal activity, and treatment options.
- Discuss the uses, general drug action, general adverse reactions, contraindications, precautions, and interactions of the cardiotonic and inotropic drugs.
- Discuss the use of other drugs with positive inotropic action.
- Discuss important preadministration and ongoing assessment activities the nurse should perform on the patient taking a cardiotonic or inotropic drug.
- List some nursing diagnoses particular to a patient taking a cardiotonic or inotropic drug.
- Identify the symptoms of digitalis toxicity.
- Discuss ways to promote an optimal response to therapy, how to manage common adverse reactions, and important points to keep in mind when administering a cardiotonic drug.

The cardiotonics are drugs used to increase the efficiency and improve the contraction of the heart muscle, which leads to improved blood flow to all tissues of the body. The drugs have long been used to treat congestive heart failure (CHF), a condition in which the heart cannot pump enough blood to meet the tissue needs of the body. While the term "congestive heart failure" continues to be used by some, a more accurate term is simply "heart failure."

About 4.5 million Americans have heart failure (HF). It is the most frequent cause of hospitalization for individuals older than 65 years. Some patients, with treatment, may lead nearly normal lives, whereas more than 50% of individuals with severe HF die each year. HF is a complex clinical syndrome that can result from any number of cardiac or metabolic disorders such as ischemic heart disease, hypertension, or hyperthyroidism. Any condition that impairs the ability of the ventricle to pump blood can lead to HF. In HF, the heart fails in its ability to pump enough blood to meet the needs of the body or can do so only with an elevated filling pressure. Recently it was discovered that HF causes a number of neurohormonal changes as the body tries to compensate for the increased workload of the heart. Display 39-1 discusses this neurohormonal response.

The sympathetic nervous system increases the secretions of the catecholamines (neurohormones epinephrine and norepinephrine), which results in increased heart rate and vasoconstriction. The activation of the renin-angiotensin-aldosterone (RAA) system occurs because of decreased perfusion to the kidneys. As the RAA system is activated, increased levels of angiotensin II and aldosterone occur, which increases the blood pressure, adding to the workload of the heart. These increases in neurohormonal activity cause a remodeling (restructuring) of the cardiac muscle cells, leading to hypertrophy of the heart, increased need for oxygen, and cardiac necrosis, which worsens the HF. The tissue of the heart is changed

DISPLAY 39-1 ● Neurohormonal Responses Affecting Heart Failure

The body activates the neurohormonal compensatory mechanisms, which result in:

- Increased secretion of the neurohormones by the sympathetic nervous system
- Activation of the renin-angiotensin-aldosterone (RAA) system
- Remodeling of the cardiac tissue

in a manner to increase the cellular mass of cardiac tissue, change the shape of the ventricle(s), and reduce the heart's ability to contract effectively.

Heart failure is best described as denoting the area of initial ventricle dysfunction: left-sided (left ventricular) dysfunction and right-sided (right ventricular) dysfunction. Left ventricular dysfunction leads to pulmonary symptoms such a dyspnea and moist cough. Right ventricular dysfunction leads to neck vein distention, peripheral edema, weight gain, and hepatic engorgement. Because both sides of the heart work together, ultimately both sides are affected in HF. Typically the left side of the heart is affected first, followed by right ventricular involvement.

The most common symptoms associated with HF include:

Left Ventricular Dysfunction

- Shortness of breath with exercise or difficulty breathing when lying flat
- Dry, hacking cough or wheezing
- Orthopnea (difficulty breathing while lying flat)
- Restlessness and anxiety

Right Ventricular Dysfunction

- Swollen ankles, legs, or abdomen, leading to pitting edema
- Anorexia
- Nausea
- Nocturia (the need to urinate frequently at night)
- Weakness
- Weight gain as the result of fluid retention

Other symptoms include:

- Palpitations, fatigue, or pain when performing normal activities
- Tachycardia or irregular heart rate
- Dizziness or confusion

Left ventricular dysfunction, also called left ventricular systolic dysfunction, is the most common form of heart failure and results in decreased cardiac output and decreased ejection fraction (the amount of blood that the ventricle ejects per beat in relationship to the amount of blood available to eject). Typically, the ejection fraction should be greater than 60%. With, left ventricular systolic dysfunction, the ejection fraction in less than 40%, and the heart is enlarged and dilated.

Until recently, the cardiotonics and a diuretic were the treatment of choice for HF. However, other drugs such as the angiotensin-converting enzyme (ACE) inhibitors, and beta blockers have become the treatment of choice during the last several years. See Figure 39-1 for an example of a method of determining treatment for left ventricular systolic dysfunction. See Chapters 23, 42, and 46 for more information on the beta blockers, ACE inhibitors, and diuretics, respectively.

CARDIOTONICS

Digoxin (Lanoxin) is the most commonly used cardiotonic drug. Other terms used to identify the cardiotonics are **cardiac glycosides** or **digitalis glycosides**. The digitalis or cardiac glycosides are obtained from the leaves of the purple foxglove plant or the *Digitalis purpurea* and the *Digitalis lanata*.

Miscellaneous drugs with positive inotropic action such as inamrinone and milrinone (Primacor) are nonglycosides used in the short-term management of HF. Although in the past the cardiotonics were the mainstay in the treatment of HF, currently they are used as the fourth line of treatment for patients who continue to experience symptoms after using the ACE inhibitors, diuretics, and beta blockers. See the Summary Drug Table: Cardiotonics and Miscellaneous Inotropic Drugs for information concerning these drugs.

ACTIONS

Digitalis acts in two ways:

1. Increases cardiac output through positive inotropic activity
2. Decreases the conduction velocity through the atrioventricular (AV) and sinoatrial (SA) nodes in the heart

Increased Cardiac Output

Cardiotonic drugs increase the force of the contraction of the muscle (myocardium) of the heart. This is called a **positive inotropic action**. When the force of contraction of the myocardium is increased, the amount of blood leaving the left ventricle at the time of each contraction is increased. When the amount of blood leaving the left ventricle is increased, **cardiac output** (the amount of blood leaving the left ventricle with each contraction) is increased.

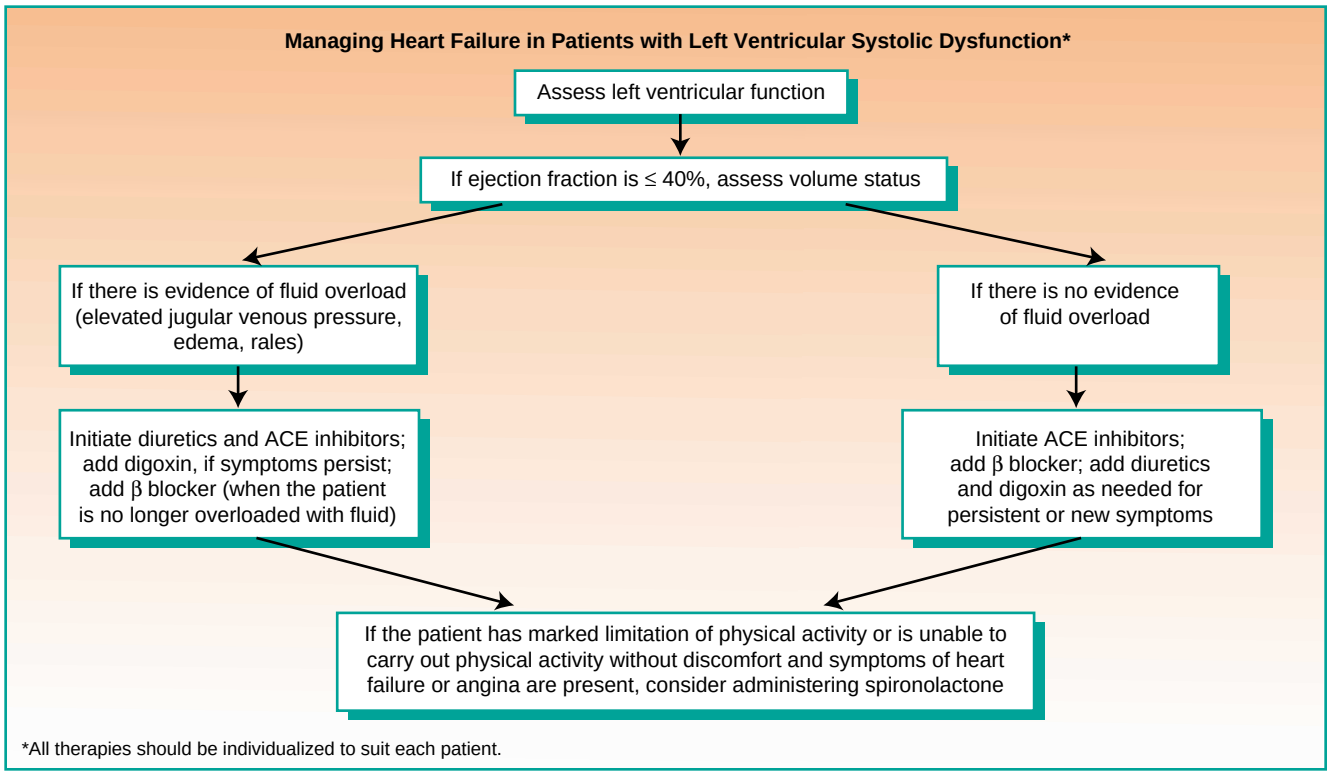

FIGURE 39-1. Management of left ventricular systolic dysfunction. (Adapted from Ammon, S. [2001]. Managing patients with heart failure, *AJN 101* [12] 35.)

The most profound effect of a cardiotonic drug occurs in patients with HF. In HF, the heart, weakened by disease or age, cannot pump a sufficient amount of blood to meet the demands of the body. The weakened heart results in a decrease in the amount of oxygenated blood leaving the left ventricle during each myocardial contraction (a decrease in cardiac output). A marked decrease in cardiac output deprives the kidneys, brain, and other vital organs of an adequate blood supply. The weakened heart is unable to pump enough circulated blood back into the heart. The blood accumulates or congests in the body's tissues. With congestion, legs and ankles swell. Fluid collects in the lungs, and the individual finds it increasingly hard to breathe, especially when lying down. When the kidneys are deprived of an adequate blood supply, they are unable to effectively remove water, electrolytes, and waste products from the bloodstream. Excess fluid (edema) may occur in the lungs or tissues, increasing the congestion. The body then attempts to make up for this deficit by increasing the heart rate, which in turn circulates more blood through the kidneys, brain, and other vital organs. In many instances, an increase in the heart rate ultimately fails to deliver an adequate amount of blood to the kidneys and other vital organs. An increased heart rate also places added strain on the heart's muscle, which may further weaken the heart. Untreated, congestion worsens and may prevent the heart form pumping enough blood to keep the individual alive.

When a cardiotonic drug is administered, the positive inotropic action increases the force of the contraction, resulting in an increased cardiac output. When cardiac output is increased, the blood supply to the kidneys and other vital organs is increased. Water, electrolytes, and waste products are removed in adequate amounts, and the symptoms of inadequate heart action or HF are relieved. In most instances, the heart rate also decreases. This occurs because vital organs are now receiving an adequate blood supply because of the increased force of myocardial contraction.

Depression of the Sinoatrial and Atrioventricular Nodes

The cardiotonics affect the transmission of electrical impulses along the pathway of the conduction system of the heart. The conduction system of the heart is a group of specialized nerve fibers consisting of the SA node, the AV node, the bundle of His, and the branches of Purkinje (Fig. 39-2). Each heartbeat (or contraction of the ventricles) is the result of an electrical impulse that normally starts in the SA node, is then received by the AV node, and travels down the bundle of His and through the Purkinje fibers (see Fig. 39-2). The heartbeat can be felt as a pulse at the wrist and other areas of the body where an artery is close to the surface or lies near a bone. When the electrical impulse reaches the

SUMMARY DRUG TABLE CARDIOTONICS AND MISCELLANEOUS INOTROPIC DRUGS

GENERIC NAME	TRADE NAME*	USES	ADVERSE REACTIONS	DOSAGE RANGES
Cardiotonics				
digoxin *di-jox'-in*	Digitek, Lanoxicaps, Lanoxin, *generic*	Heart failure (HF), atrial fibrillation, atrial flutter, paoxysmal atrial tachycardia	Headache, weakness, drowsiness, visual disturbances, nausea, vomiting, anorexia, arrhythmias	Loading dose: 0.75–1.25 mg or 0.125–0.25 mg IV; maintenance: 0.125–0.25 mg/d PO
Miscellaneous Inotropic Drugs				
inamrinone lactate *in-am'-ri-none*	Inocor, *generic*	Short-term management of HF in patients with no response to digitalis, diuretics, or vasodilators	Arrhythmia, hypotension, nausea, vomiting, abdominal pain, anorexia, hepatotoxicity	IV: 0.75 mg/kg bolus, may repeat in 30 min; maintenance: IV 5–10 μg/kg/min, not to exceed 10 mg/kg/d
milrinone lactate *mill'-ri-none*	Primacor	HF	Ventricular arrhythmias, hypotension, angina/chest pain, headaches, hypokalemia	IV: up tp 1.13 mg/kg/d
Antidote Digoxin Specific				
digoxin immune fab (ovine)	Digibind	Antidote for digoxin toxicity	Hypokalemia, re-emergence of artial fibrillation or CHF	IV: dosage depends on serum digoxin level or estimate of the amount of digoxin ingested; average dose up to 800 mg (20 vials)

*The term *generic* indicates the drug is available in generic form.

Purkinje fibers, the ventricles contract. Normally, once the ventricles contract, another electrical impulse is generated by the SA node, and the cycle begins again. Cardiotonic drugs depress the SA node and slow conduction of the electrical impulse to and through the AV node. Slowing this part of the transmission of nerve impulses decreases the number of impulses and the number of ventricular contractions per minute, thereby decreasing the heart rate and allowing the heart to function more normally. The therapeutic effects of digoxin on atrial arrhythmias are thought to be related to the depressive action on the SA and AV nodes and baroreceptor sensitization.

USES

The cardiotonics are used to treat HF and atrial fibrillation. **Atrial fibrillation** is a cardiac arrhythmia characterized by rapid contractions of the atrial myocardium, resulting in an irregular and often rapid ventricular rate. See Chapter 40 for more information on various arrhythmias and treatment.

ADVERSE REACTIONS

Adverse reactions are dose dependent. Dosages are individualized based on several factors, including the following:

- The ideal body weight of the patient;
- The patient's renal function, evaluated on creatinine clearance;
- The patient's age (infants and children require lower dosages, and advanced age may be indicative of decreased renal function, requiring a lower dosage); and
- Current medications, other medical problems, or other factors affecting the activity of digoxin.

Because some patients are more sensitive to side effects with digoxin, the dosage is selected carefully and adjusted as the clinical condition indicates. Adverse reactions were more common and severe in past years before careful attention to weight, renal function, and the concurrent administration of certain medications was given. The incidence and severity of digoxin toxicity has decreased significantly in recent years.

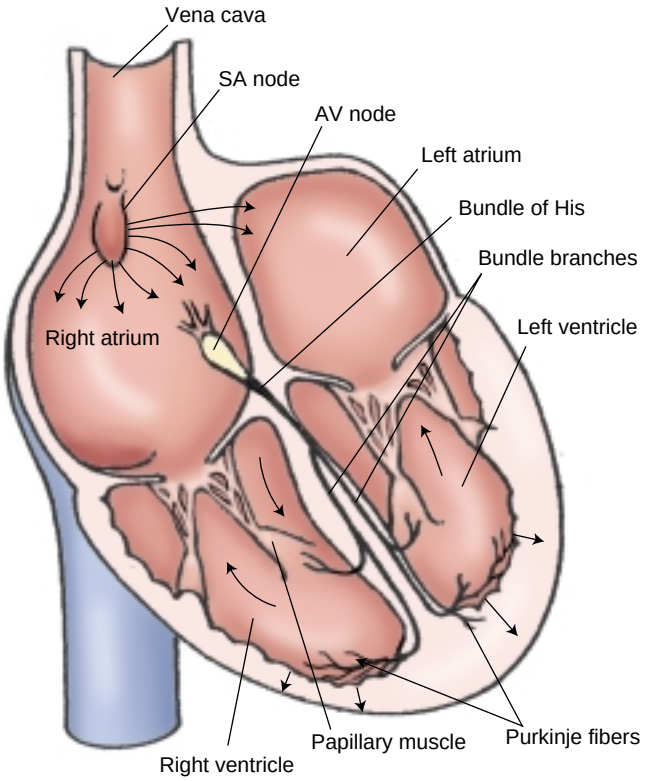

FIGURE 39-2. The conducting system of the heart. Impulses originating in the SA node are transmitted through the atria to the AV node down the bundle of His and the bundle branches through the Purkinje fibers to the ventricles.

There is a narrow margin of safety between the full therapeutic effects and the toxic effects of cardiotonic drugs. Even normal doses of a cardiotonic drug can cause toxic drug effects. Because substantial individual variations may occur, it is important to individualize the dosage. The term **digitalis toxicity** (digitalis intoxication) is used when toxic drug effects occur when digoxin is administered. The signs of digitalis toxicity are listed in Display 39-2.

Digoxin has a rapid onset and a short duration of action. Once the drug is withheld, the toxic effects of digoxin will disappear rapidly. At times, the primary care provider may deem it necessary to administer digoxin immune fab (Digibind) when serious life-threatening digoxin overdosage occurs.

DISPLAY 39-2 ● Signs of Digitalis Toxicity

- Gastrointestinal—anorexia (usually the first sign), nausea, vomiting, diarrhea
- Muscular—weakness
- Central nervous system—headache, apathy, drowsiness, visual disturbances (blurred vision, disturbance in yellow/green vision, halo effect around dark objects), mental depression, confusion, disorientation, delirium
- Cardiac—changes in pulse rate or rhythm; electrocardiographic changes, such as bradycardia, tachycardia, premature ventricular contractions, bigeminal (two beats followed by a pause), or trigeminal (three beats followed by a pause) pulse. Other arrhythmias (abnormal heart rhythms) also may be seen.

CONTRAINDICATIONS

The cardiotonics are contraindicated in patients with known hypersensitivity, ventricular failure, ventricular tachycardia, or AV block and in the presence of digitalis toxicity.

PRECAUTIONS

The cardiotonics are given cautiously in patients with electrolyte imbalance (especially hypokalemia, hypocalcemia, and hypomagnesemia), severe carditis, heart block, myocardial infarction, severe pulmonary disease, acute glomerulonephritis, and impaired renal or hepatic function. Digoxin and digoxin immune fab are classified as Pregnancy Category C drugs. Fetal toxicity and neonatal death have been reported from maternal digoxin overdosage. These drugs are used only when the potential benefit outweighs the potential harm to the fetus.

INTERACTIONS

When the cardiotonics are taken with food, absorption is slowed, but the amount absorbed is the same. However, if taken with high-fiber meals, absorption of the cardiotonics may be decreased. The cardiotonics react with many different drugs. Drugs that may increase plasma digitalis levels leading to toxicity include amiodarone, benzodiazepines, cyclosporine, diphenoxylate, indomethacin, itraconazole, macrolides (erythromycin, clarithromycin), propafenone, quinidine, quinine, spironolactone, tetracyclines, and verapamil. Drugs that may decrease plasma digitalis levels include the oral aminoglycosides, antacids, antineoplastics (bleomycin, carmustine, cyclophosphamide, methotrexate, and vincristine), activated charcoal, cholestyramine, colestipol, kaolin/pectin, neomycin, penicillamine, rifampin, St. John's wort, and sulfasalazine. The thyroid hormones may decrease the effectiveness of digitalis glycosides, requiring a larger dosage of digoxin. Thiazide and loop diuretics may increase diuretic-induced electrolyte disturbances, predisposing the patient to digitalis-induced arrhythmias.

Patients taking a diuretic and a digitalis glycoside must be monitored closely. Thiazide and loop diuretics (see Chap. 46) may increase the risk and effects of toxicity.

MISCELLANEOUS INOTROPIC DRUGS

Inamrinone and milrinone have inotropic actions and are used in the short-term management of severe HF that is not controlled by the digitalis preparations. Milrinone is used more often than inamrinone, appears to be more effective, and has fewer adverse reactions. Both drugs are given intravenously (IV), and close monitoring is required during therapy. The nurse must continuously monitor the patient's heart rate and blood pressure with administration of either drug. If hypotension occurs, use of the drug is discontinued or the rate of administration is reduced. Continuous cardiac monitoring is necessary because life-threatening arrhythmias may occur. These drugs do not cure, but rather control, the signs and symptoms of HF.

NURSING PROCESS

The Patient Receiving a Cardiotonic Drug

ASSESSMENT

Preadministration Assessment

The cardiotonics are potentially toxic drugs. Therefore, the nurse must observe the patient closely, especially during initial therapy. Before therapy is started, the physical assessment should include information that will establish a database for comparison during therapy. The physical assessment should include:

- Taking blood pressure, apical-radial pulse rate, respiratory rate;
- Auscultating the lungs, noting any unusual sounds during inspiration and expiration;
- Examining the extremities for edema;
- Checking the jugular veins for distention;
- Measuring weight;
- Inspecting sputum raised (if any), and noting the appearance (eg, frothy, pink-tinged, clear, yellow); and
- Looking for evidence of other problems, such as cyanosis, shortness of breath on exertion (if the patient is allowed out of bed) or when lying flat, and mental changes.

The primary care provider also may order laboratory and diagnostic tests, such as an electrocardiogram, renal and hepatic function tests, complete blood count, serum enzymes, and serum electrolytes. These tests should be reviewed before the first dose of the drug is given. Renal function is particularly important because a diminished renal function could affect the dosage of digoxin. When subsequent laboratory tests are ordered, they also should be reviewed when the results are recorded on the patient's record. Because digoxin reacts with many medications, the nurse must take a careful drug history.

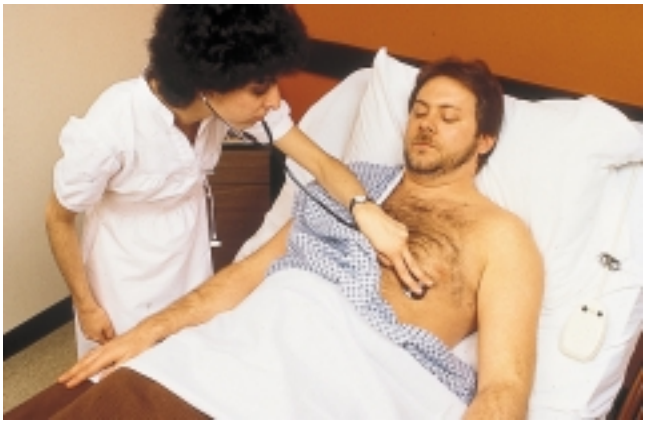

FIGURE 39-3. The nurse counts the apical pulse for 1 minute prior to administering the cardiotonic.

Before administering the first dose of the drug, the nurse takes the patient's vital signs and documents the apical pulse rate and rhythm.

Ongoing Assessment

Before administering each dose of a cardiotonic, the nurse takes the apical pulse rate for 60 seconds (see Fig. 39-3). The nurse records the apical pulse rate in the designated area on the chart or the medication administration record. The nurse withholds the drug and notifies the primary care provider if the pulse rate is below 60 bpm in adults (below 70 bpm in a child and below 90 bpm in an infant) or greater than 100 bpm, unless there is a written order giving different guidelines for withholding the drug.

Nursing Alert

The drug should also be withheld and the physician contacted if there are any signs of digitalis toxicity, there is any change in the pulse rhythm, there is a marked increase or decrease in the pulse rate since the last time it was taken, or the patient's general condition appears to have worsened.

Nursing Alert

Plasma digoxin levels are monitored closely. Blood for plasma levels may be drawn 6 to 8 hours after the last dose or immediately before the next dose. Plasma digoxin levels greater than 2 ng/mL are reported to the physician.

Digitalis toxicity can occur even when normal doses are being administered or when the patient has been receiving a maintenance dose. Many symptoms of toxicity are similar to the symptoms of the heart conditions for which the patient is receiving the cardiotonic. This makes careful assessment of the patient by the nurse a critical aspect of care.

The nurse weighs patients receiving a cardiotonic drug daily or as ordered. The intake and output are measured, especially if the patient has edema or HF or is also receiving a diuretic. Throughout therapy, the nurse assesses the patient for peripheral edema and auscultates the lungs for rales/crackles throughout therapy. Serum electrolyte levels should be obtained periodically. Hypokalemia, hypomagnesemia, or hypercalcemia may increase the risk for toxicity. Any electrolyte imbalance is reported to the primary care provider.

NURSING DIAGNOSES

Drug-specific nursing diagnoses are highlighted in the Nursing Diagnoses Checklist. Other nursing diagnoses applicable to these drugs are discussed in depth in Chapter 4.

PLANNING

The expected outcomes of the patient may include an optimal response to therapy, management of common adverse reactions, and an understanding of and compliance with the postdischarge drug regimen.

IMPLEMENTATION

Promoting an Optimal Response to Therapy

Great care must be taken when administering a cardiotonic drug. References should be consulted for average digitalizing and maintenance doses. In addition, the nurse should carefully check the primary care provider's order and the drug container. If there is any doubt about the dosage or calculation of the dosage, the nurse checks with the primary care provider or pharmacist before giving the drug.

DIGITALIZATION. Patients started on therapy with a cardiotonic are being "digitalized." Digitalization may be accomplished by two general methods:

- Rapid digitalization (accomplished by administering a loading dose) ; or
- Gradual digitalization (giving a maintenance dose allowing the body to gradually accumulate therapeutic blood levels).

Nursing Diagnoses Checklist

- ✓ **Decreased Cardiac Output** related to decreased contractibility of the heart muscle, adverse reactions (cardiac arrhythmias)
- ✓ **Risk for Imbalanced Nutrition: Less than Body Requirements** related to adverse reactions (anorexia, nausea, vomiting)
- ✓ **Disturbed Sensory Perception** related to adverse drug reactions (digitalis toxicity)

Digitalization is a series of doses given until the drug begins to exert a full therapeutic effect. The digitalizing, or loading dose, is administered in several doses, with approximately half the total digitalization dose administered as the first dose. Additional fractions of the digitalis dose are administered at 6- to 8-hour intervals. Once a full therapeutic effect is achieved, the patient is usually prescribed a maintenance dose schedule. The ranges for digitalizing (loading) and maintenance doses are given in the Summary Drug Table: Cardiotonics and Miscellaneous Inotropic Drugs. Digoxin injections are usually used for rapid digitalization; digoxin tablets or capsules are used for mainenance therapy.

Digitalizing doses vary, and the primary care provider may decide to achieve full digitalization rapidly or slowly, depending on the patient's diagnosis, age, current condition, and other factors.

During digitalization, the nurse takes the blood pressure, pulse, and respiratory rate every 2 to 4 hours or as ordered by the primary care provider. This time interval may be increased or decreased, depending on the patient's condition and the route used for administration.

Serum levels (digoxin) may be ordered daily during the period of digitalization and periodically during maintenance therapy. Periodic electrocardiograms, serum electrolytes, hepatic and renal function tests, and other laboratory studies also may be ordered.

PARENTERAL ADMINISTRATION. The nurse may give a cardiotonic orally, IV, or intramuscularly. When a cardiotonic is given IV, it is administered slowly. If the patient is receiving the drug IV, the nurse assesses the IV site for redness or infiltration. Extravasation can lead to tissue irritation and sloughing. When given intramuscularly, the nurse should rotate the injection sites. To rotate injection sites correctly, the nurse inserts a diagram showing the order of rotation in the chart or the medication administration record. Each time the drug is given, the injection site is recorded in the patient's chart. However, intramuscular injection is not recommended for these drugs.

ORAL ADMINISTRATION. The nurse can administer oral preparations without regard to meals. Tablets can be crushed and mixed with food or fluids if the patient has difficulty swallowing. Do not alternate between the dosage forms (ie, the tablets and the capsules). Dosages are not the same. The recommended dosage of the capsules is 80% of the dosage for tablets and elixir.

Monitoring and Managing Adverse Drug Reactions

The nurse observes for signs of digitalis toxicity every 2 to 4 hours during digitalization and 1 to 2 times a day when a maintenance dose is being given. When digitalis toxicity develops, the primary care provider may

discontinue digitalis use until all signs of toxicity are gone. If severe bradycardia occurs, atropine (see Chap. 25) may be ordered. If digoxin has been given, the primary care provider may order blood tests to determine drug serum levels. The therapeutic serum level of digoxin is 0.8 to 2 ng/mL, and the toxic serum level is more than 2.5 ng/mL.

Nursing Alert

The nurse should withhold the drug and report any of the following signs of digitalis toxicity to the physician immediately: loss of appetite (anorexia), nausea, vomiting, abdominal pain, visual disturbances (blurred, yellow or green vision and white halos, borders around dark objects), and arrhythmias (any type). The nurse also must immediately report serum digoxin levels greater than 2.0 ng/mL.

Gerontologic Alert

Older adults are particularly prone to digitalis toxicity. All older adults must be carefully monitored for signs of digitalis toxicity.

The nurse must also closely observe the patient for other adverse drug reactions, such as anorexia, nausea, vomiting, and diarrhea. Some adverse drug reactions are also signs of digitalis toxicity, which can be serious. The nurse should carefully consider any patient complaint or comment, record it on the patient's chart, and bring it to the attention of the primary care provider.

Diuretics (see Chap. 46) may be ordered for some patients receiving a cardiotonic drug. Diuretics, as well as other conditions or factors, such as gastrointestinal suction, diarrhea, and old age, may produce low serum potassium levels (**hypokalemia**). The primary care provider may order a potassium salt to be given orally or IV.

Nursing Alert

Hypokalemia makes the heart muscle more sensitive to digitalis, thereby increasing the possibility of developing digitalis toxicity. The nurse must closely, and at frequent intervals, observe patients with hypokalemia for signs of digitalis toxicity.

Patients with hypomagnesemia (low magnesium plasma levels) are at increased risk for digitalis toxicity. If low magnesium levels are detected, the primary care provider may prescribe magnesium replacement therapy.

Most often digoxin toxicity can be successfully treated by simply withdrawing the drug. However, severe life-threatening toxicity is treated with digoxin immune fab (Digibind). Digoxin immune fab, composed of digoxin-specific antigen-binding fragments (fab), is used as an antidote in the treatment of digoxin overdosage. The dosage varies with the amount of digoxin ingested and is administered by the IV route during a 30-minute period. Most life-threatening states can be adequately treated with 800 mg of digoxin immune fab (20 vials). Few adverse reactions have been observed with the use of immune fab. However, the nurse should be alert for the possibility of worsening of HF, low cardiac output, hypokalemia, or atrial fibrillation. Hypokalemia is of particular concern in patients taking digoxin immune fab, particularly because hypokalemia usually coexists with toxicity. (See the Summary Drug Table: Cardiotonics and Miscellaneous Inotropic Drugs.)

Educating the Patient and Family

In some instances, a cardiotonic may be prescribed for a prolonged period. Some patients may discontinue use of the drug, especially if they feel better and their original symptoms have been relieved. The patient and family must understand that the prescribed drug must be taken exactly as directed by the primary care provider.

The primary care provider may want the patient to monitor the pulse rate daily during cardiotonic therapy. The nurse shows the patient or a family member the correct technique for taking the pulse (see Home Care Checklist: Monitoring Pulse Rate). The primary care provider may also want the patient to omit the next dose of the drug and call him or her if the pulse rate falls below a certain level (usually 60 bpm in an adult, 70 bpm in a child, and 90 bpm in an infant). These instructions are emphasized at the time of patient teaching. The nurse includes the following points in a teaching plan for the patient taking a cardiac glycoside drug:

- Do not discontinue use of this drug without first checking with the primary care provider (unless instructed to do otherwise). Do not miss a dose or take an extra dose.
- Take this drug at the same time each day.
- Take your pulse before taking the drug, and withhold the drug and notify the primary care provider if your pulse rate is less than 60 bpm or greater than 100 bpm.
- Avoid antacids and nonprescription cough, cold, allergy, antidiarrheal, and diet (weight-reducing) drugs unless their use has been approved by the primary care provider. Some of these drugs interfere with the action of the cardiotonic drug or cause other, potentially serious, problems. (See Interactions.")
- Contact the primary care provider if nausea, vomiting, diarrhea, unusual fatigue, weakness, vision change (such as blurred vision, changes in colors of objects, or halos around dark objects), or mental depression occurs.

Home Care Checklist

MONITORING PULSE RATE

Monitoring a patient's pulse rate is second nature when the patient is in an acute care facility. However, when the patient goes home with digoxin, he or she will need to monitor the pulse rate to prevent possible adverse reactions. The nurse teaches the patient to perform the following steps:

- ☑ Have a watch with a second hand with you.
- ☑ Sit down and rest your nondominant arm on a table or chair armrest.
- ☑ Place the index and third fingers of your dominant hand just below the wrist bone on the thumb side of your nondominant arm.
- ☑ Feel for a beating or pulsing sensation. This is your pulse.
- ☑ Count the number of beats for 30 seconds (if the pulse is regular) and multiply by 2. If the pulse is irregular, count the number of beats for 60 seconds.
- ☑ Record the number of beats of your pulse and keep a log of your reading.
- ☑ If you notice the pulse rate greater than 100 bpm or less than 60 bpm, call your health care provider immediately.

- Carry an identification card describing the disease process and your medication regimen.
- Keep the drug in its original container.
- Follow the dietary recommendations (if any) made by the primary care provider.
- The primary care provider will closely monitor therapy. Keep all appointments for primary care provider visits or laboratory or diagnostic tests.

EVALUATION

- The therapeutic effect is achieved.
- Adverse reactions are identified, reported to the primary care provider, and managed using appropriate nursing interventions.
- The patient verbalizes the importance of continued follow-up care.
- The patient verbalizes the importance of complying with the prescribed therapeutic regimen.
- The patient and family demonstrate an understanding of the drug regimen.
- The patient complies with the prescribed drug regimen.

Critical Thinking Exercises

1. *Mr. Taylor has been taking digoxin for 3 weeks and has come to the clinic for a follow-up visit. Analyze the situation to determine what questions you would ask Mr. Taylor during the interview to evaluate his knowledge of the drug regimen and to find out if he is experiencing any adverse reactions.*
2. *You are to participate in a team conference on the cardiac glycosides. Your topic to discuss is discharge teaching for the patient receiving a cardiac glycoside. Develop a teaching plan using the nursing process as a framework. Determine what points would be most important for you to include.*
3. *Discuss when you would expect the primary care provider to order digoxin immune fab. State the assessment you feel would be most important and give a rationale.*

Review Questions

1. Which of the following is commonly associated with left ventricular systolic dysfunction?
   - **A.** Ejection fraction of 60% or more
   - **B.** Ejection fraction below 40%
   - **C.** Increased cardiac output
   - **D.** Normal cardiac output
2. Which of the following serum digoxin levels would be most indicative that a patient taking digoxin may be experiencing toxicity?
   - **A.** 0.5 ng/mL
   - **B.** 0.8 ng/mL
   - **C.** 1.0 ng/mL
   - **D.** 2.0 ng/mL

3. In which of the following situations would the nurse withhold a dosage of digoxin and notify the primary care provider?
   - **A.** A pulse rate greater than 100 bpm
   - **B.** A pulse rate less than 100 bpm
   - **C.** A pulse rate of 60 bpm
   - **D.** A pulse rate of 72 bpm

4. Which drug would the nurse expect to be prescribed for a patient with digoxin toxicity?
   - **A.** Digoxin immune fab
   - **B.** Milrinone
   - **C.** Inamrinone lactate
   - **D.** Any inotropic drug

5. During rapid digitalization the nurse expects the first dose to _____.
   - **A.** be the smallest dose in case the patient is allergic to digoxin
   - **B.** be given orally, with succeeding doses given intravenously
   - **C.** be approximately half of the total digitalization dose
   - **D.** be approximately three quarters of the total digitalization dose

● Medication Dosage Problems

1. Digoxin (Lanoxin) is prescribed for a patient with HF, and digitalization is begun. The primary health care provider prescribes digoxin (Lanoxin) 0.75 mg PO as the initial dose. Available are digoxin tablets of 0.5 and 0.25 mg. The nurse administers _____.

2. Digoxin 0.5 mg IV is prescribed. The drug is available in a solution of 0.25 mg/mL. How many mL will the nurse prepare?