



Wolters Kluwer

When you have to be right

# **Introduction to Clinical Pharmacology**

## **Chapter 37**

### **Cardiotonic and Antiarrhythmic Drugs**

# Learning Objectives #1

---

1. Compare and contrast heart failure in relationship to left ventricular failure, right ventricular failure, neurohormonal activity, and treatment options.
2. Describe the different types of cardiac arrhythmias.
3. Explain the uses, general drug actions, general adverse reactions, contraindications, precautions, and interactions of the cardiotonic and antiarrhythmic drugs.
4. Discuss the use of other drugs with positive inotropic action.

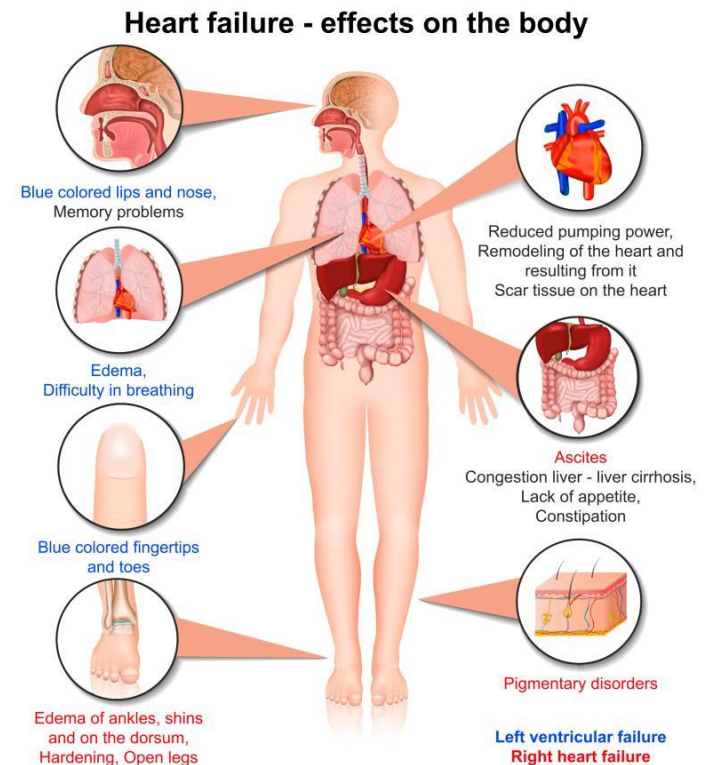
## Learning Objectives #2

---

5. Distinguish important preadministration and ongoing assessment activities the nurse should perform on the client taking a cardiotonic or antiarrhythmic drug.
6. List nursing diagnoses particular to a client taking a cardiotonic or antiarrhythmic drug.
7. Identify the symptoms of digitalis toxicity.
8. Examine ways to promote an optimal response to therapy, how to manage common adverse reactions, and important points to keep in mind when administering cardiotonic and antiarrhythmic drugs.

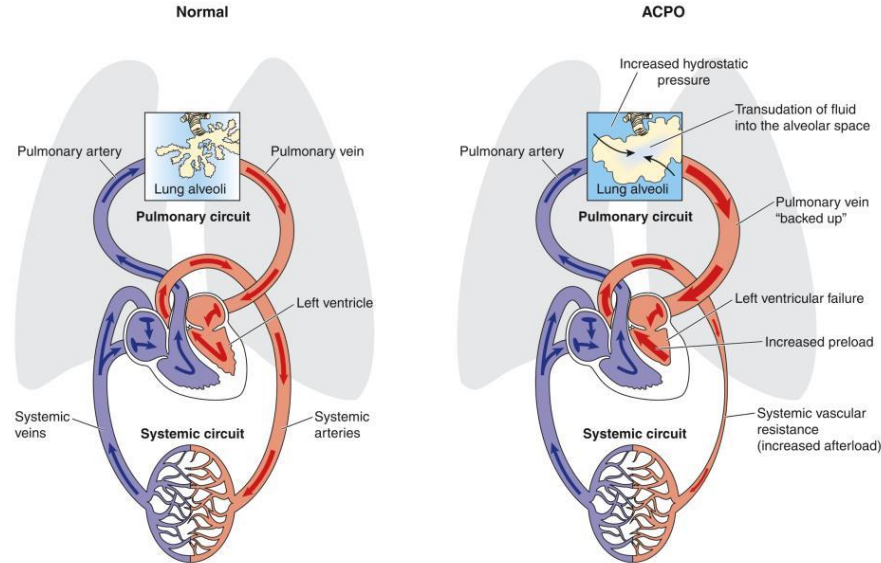
# Heart Failure

- ❖ Heart cannot pump enough blood to meet the tissue needs of the body, commonly called congestive heart failure



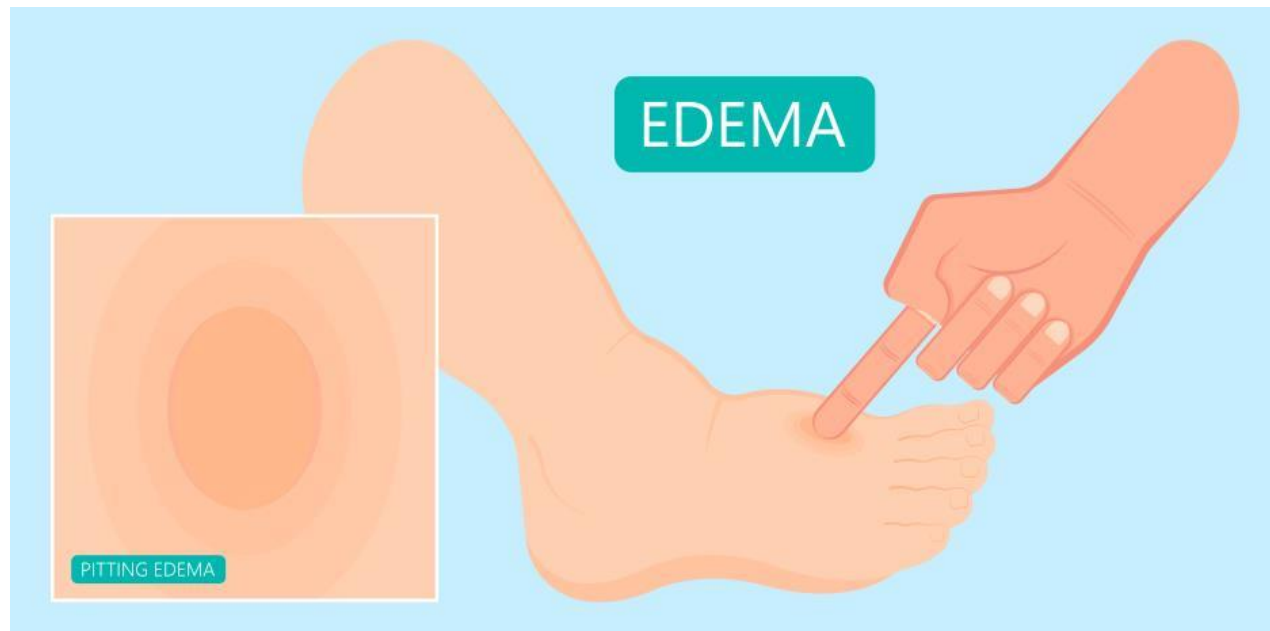
# Left Ventricular Dysfunction

- ❖ Condition in which fluids back up previous to the left ventricle of the heart and is characterized by shortness of breath and moist cough in HF



# Right Ventricular Dysfunction

- ❖ Condition in which fluid backs up previous to the right ventricle of the heart and is characterized by peripheral edema and venous congestion in heart failure

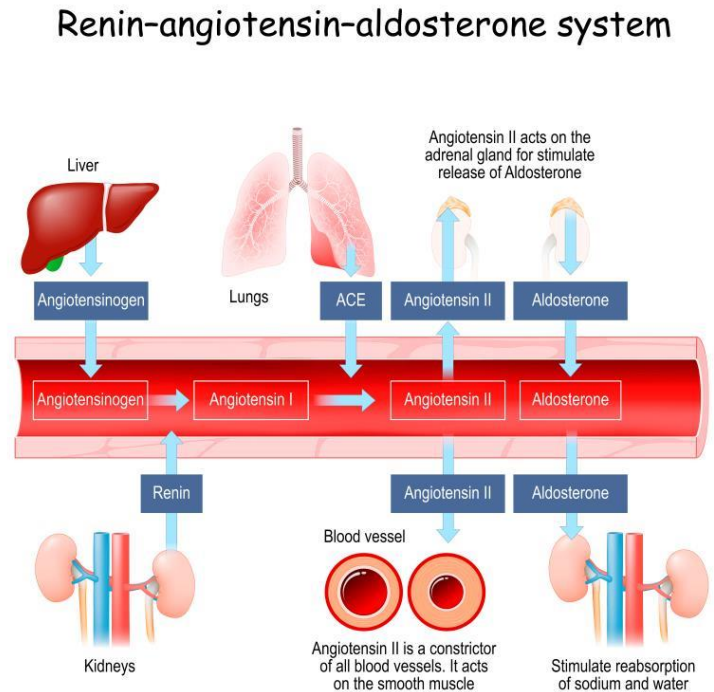


# Neurohormonal Activity

- ❖ In heart failure, the body activates the neurohormonal compensatory mechanisms which result in:
  - increased secretions of neurohormones by the sympathetic nervous system (epinephrine and norepinephrine)
  - activation of the renin-angiotensin-aldosterone system
  - remodeling of cardiac tissue (hypertrophy)
- ❖ Resulting in arteriolar vasoconstriction, tachycardia, myocardial contractility, and cardiac necrosis which leads to worsening of heart failure and reduced ability of the heart to contract effectively

# Renin–Angiotensin–Aldosterone System

- ❖ Activation of the renin–angiotensin–aldosterone (RAA) system occurs because of decreased perfusion to the kidneys. As the RAA system is activated, angiotensin II and aldosterone levels increase, which increases the blood pressure, adding to the workload of the heart





# Cardiotonics

- ❖ Class of drugs that are 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
- ❖ Also called cardiac glycosides or digitalis glycosides
- ❖ Example: Digoxin



# Cardiotonics—Actions

- ❖ Increase cardiac output through positive inotropic activity (increase in force of the contraction)
- ❖ Slow the conduction velocity through the AV node in the heart and decrease the heart rate through a negative chronotropic effect
- ❖ Ivabradine blocks the if channel and inhibits the passing of the SA node of the heart; slows the heart rate and allows blood to fill the heart chamber
- ❖ Milrinone has inotropic action

# Cardiotonics—Uses

## ❖ Used for:

- Heart failure
- Atrial fibrillation
- Milrinone is used for the short-term management of severe heart failure not controlled by digitalis



# Cardiotonics—Adverse Reactions #1

## ❖ Central Nervous System Reactions:

- Headache
- Weakness
- Drowsiness
- Visual disturbances (blurring or yellow halo with digoxin; increased brightness with ivabradine)



# Cardiotonics—Adverse Reactions #2

## ❖ Other Reactions:

- Arrhythmias
- Nausea
- Anorexia
- Digitalis toxicity



# Cardiotonics—Contraindications

- ❖ Contraindicated in clients with:
  - known hypersensitivity to the drugs
  - digitalis toxicity
  - ventricular failure
  - ventricular tachycardia
  - cardiac tamponade
  - restrictive cardiomyopathy
  - AV block



# Cardiotonics—Precautions

- ❖ Used cautiously in clients with:
  - electrolyte imbalance (especially hypokalemia, hypocalcemia, and hypomagnesemia)
  - thyroid disorders
  - severe carditis
  - heart block
  - MI
  - severe pulmonary disease
  - acute glomerulonephritis
  - impaired renal or hepatic function
  - pregnancy (pregnancy category C)
  - lactation



# Cardiotonics—Interactions #1

Interacting Drug	Common Use	Effect of Interaction
Thyroid hormones	Treatment of hypothyroidism	Decreased effectiveness of digitalis glycosides, requiring larger dosage of digoxin
Thiazide and loop diuretics	Management of edema and hypertension	Increased diuretic-induced electrolyte disturbances, predisposing the client to digitalis-induced arrhythmias
St. John's wort	Herbal remedy to relieve depression	Decrease in serum digitalis levels



## Cardiotonics—Interactions #2

Interacting Drug	Common Use	Effect of Interaction
Amiodarone	Cardiac problems	Increased serum digoxin levels leading to toxicity
Benzodiazepines	Treatment of seizures and anxiety	
Indomethacin	Pain relief	
Itraconazole	Fungal infections	
Macrolides	Anti-infectives	
Propafenone	Cardiac problems	

## Cardiotonics—Interactions #3

Interacting Drug	Common Use	Effect of Interaction
Quinidine	Cardiac problems	Increased serum digoxin levels leading to toxicity
Spironolactone	Edema	
Tetracyclines	Anti-infectives	
Verapamil	Cardiac problems	
Oral aminoglycoside	Anti-infective	

## Cardiotonics—Interactions #4

Interacting Drug	Common Use	Effect of Interaction
Antacids	GI problems	Decreased serum digoxin levels leading to toxicity
Antineoplastics	Anticancer agents	
Activated charcoal	Antidote to poisoning with certain toxic substances	
Cholestyramine	Agent to lower high blood cholesterol levels	

## Cardiotonics—Interactions #5

Interacting Drug	Common Use	Effect of Interaction
Colestipol	Agent to lower high blood cholesterol levels	Decreased serum digoxin levels leading to toxicity
Neomycin	Agent to suppress GI bacteria before surgery	
Rifampin	Antitubercular agent	

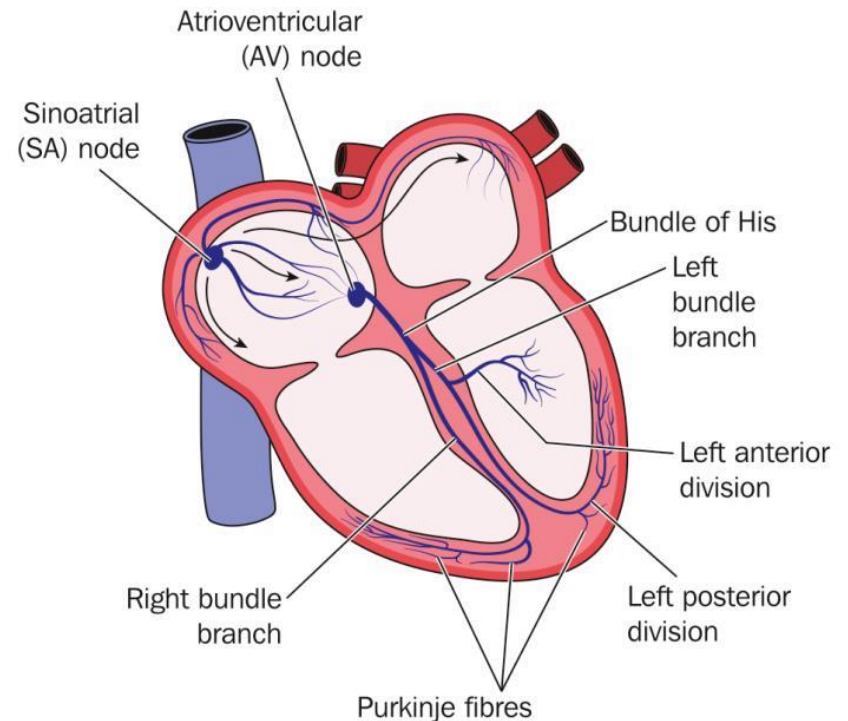
# Pharmacology in Practice Exercise #1

- ❖ A client is diagnosed with heart failure and started on digoxin. The client informs the nurse that he is taking a benzodiazepine for anxiety. Which of the following interventions should the nurse implement?
- a) Increase the dosage of digoxin
  - b) Monitor for signs of digoxin toxicity
  - c) Increase the dosage of benzodiazepine
  - d) Monitor for signs of reduced effectiveness of digoxin



# Arrhythmias

- ❖ An arrhythmia is an abnormal heart rate or rhythm; also called dysrhythmia
- ❖ The blood pumping becomes inefficient due to the pumping action being too slow or too fast
- ❖ Causes:
  - Emotional stress
  - Hypoxia
  - Electrolyte imbalance



# Types of Arrhythmias

**TABLE 37.1** Types of Arrhythmias

ARRHYTHMIA	DESCRIPTION
Atrial flutter	Rapid contraction of the atria (up to 300 bpm) at a rate too rapid for the ventricles to pump efficiently.
Atrial fibrillation	Irregular and rapid atrial contraction, resulting in a quivering of the atria and causing an irregular and inefficient ventricular contraction.
Premature ventricular contractions	Beats originating in the ventricles instead of the sinoatrial node in the atria, causing the ventricles to contract before the atria and resulting in a decrease in the amount of blood pumped to the body.
Ventricular tachycardia	A rapid heartbeat with a rate of more than 100 bpm, usually originating in the ventricles.
Ventricular fibrillation	Rapid, disorganized contractions of the ventricles resulting in the inability of the heart to pump any blood to the body, which will result in death unless treated immediately.

# Antiarrhythmic Drugs—Actions #1

- ❖ The pathophysiology of the cardiac condition guides the use of drugs to treat cardiac conduction problems. There are five basic classes (and several subclasses) of antiarrhythmic drugs.
  - Class I: have a membrane-stabilizing or anesthetic effect on the cells of the myocardium
    - Class IA: produce moderate slowing of cardiac conduction; prolong the action potential duration
    - Class IB: selectively depress cardiac conduction; shorten the action potential duration
    - Class IC: profound slowing of conduction; slight effect on repolarization; profound slowing of conduction



# Antiarrhythmic Drugs—Actions #2

- ❖ The pathophysiology of the cardiac condition guides the use of drugs to treat cardiac conduction problems. There are five basic classes (and several subclasses) of antiarrhythmic drugs.
  - Class II Beta-Adrenergic Blockers: indirectly block calcium channels and block catecholamine-caused arrhythmias.
  - Class III Potassium Channel Blockers: prolongation of repolarization
  - Class IV Calcium Channel Blockers: depression of depolarization (phase 4); lightening of phase 1 and 2 of repolarization
  - Class V Other Agents: digoxin, adenosine, and magnesium sulfate used for specific arrhythmias

# Antiarrhythmic Drugs—Uses

- ❖ Used to treat clients with:
  - premature ventricular tachycardia
  - ventricular tachycardia
  - premature atrial contractions
  - paroxysmal atrial tachycardia
  - other atrial arrhythmias (e.g., atrial fibrillation)
  - tachycardia when rapid but short-term control of ventricular rate is desirable
  - myocardial infarction (propranolol)



# Antiarrhythmic Drugs—Adverse Reactions #1

## ❖ Central Nervous System Reactions:

- Lightheadedness
- Weakness
- Somnolence



# Antiarrhythmic Drugs—Adverse Reactions #2

## ❖ Cardiovascular System Reactions:

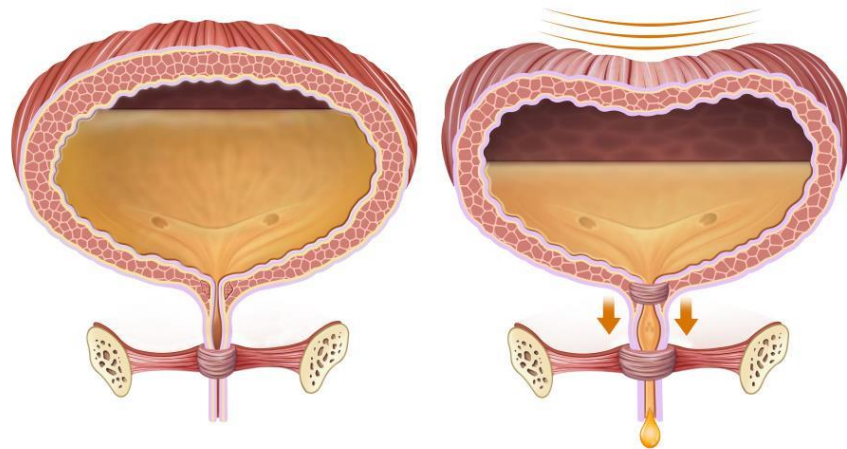
- Hypotension
- Arrhythmias
- Bradycardia



# Antiarrhythmic Drugs—Adverse Reactions #3

## ❖ Other Reactions:

- Urinary retention
- Local inflammation



# Antiarrhythmic Drugs—Contraindications

- ❖ Contraindicated in clients with:
  - known hypersensitivity to the drugs
  - pregnancy (pregnancy category D) and lactation
  - second- or third-degree AV block (if no pacemaker)
  - severe heart failure
  - aortic stenosis
  - hypotension
  - cardiogenic shock
  - myasthenia gravis or systemic lupus erythematosus (quinidine)



# Antiarrhythmic Drugs—Precautions

- ❖ Used cautiously in clients with:
  - hepatic disease
  - electrolyte disturbances
  - heart failure (quinidine, flecainide, and disopyramide)
  - renal impairment
  - pregnancy (pregnancy category B or C) or lactation
  - myasthenia gravis, urinary retention, glaucoma, or prostate enlargement (disopyramide)



# Antiarrhythmic Drugs—Interactions (Examples\*)

Interacting Drug	Common Use	Effect of Interaction
<b>Disopyramide</b>		
Clarithromycin, erythromycin,	Anti-infective agents	Increased disopyramide levels
<b>Quinidine</b>		
Cholinergic drugs	Treatment of glaucoma	Failure to terminate paroxysmal SVT
<b>Lidocaine</b>		
Beta-blockers	Hypertension and angina	Increased lidocaine levels
<b>Flecainide</b>		
Amiodarone	Cardiac problems	Increased serum flecainide levels

\*See table 37.1 for more interactions of antiarrhythmics



## Pharmacology in Practice Exercise #2

- ❖ A nurse reviews the drug history of a client who has been prescribed disopyramide for the treatment of arrhythmia. Which of the following drugs, if taken concurrently can decrease the levels of disopyramide?
- a) Erythromycin
  - b) Quinidine
  - c) Thioridazine
  - d) Rifampin



# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #1

## ❖ Preadministration Assessment

## ❖ Objective Data

- Vital signs
- Inspect physical appearance, noting skin color, temperature, and jugular vein distention
- Auscultate the lungs for unusual sounds
- Inspect sputum and note the appearance
- Palpate for pedal pulses and peripheral edema
- Weigh the client
- Lab tests: ECG, renal and hepatic
  - function tests, CBC, serum
  - electrolytes



# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #2

## ❖ Preadministration Assessment (continued)

### ❖ Subjective Data

- History of cardiac episodes
- Pain assessment if experiencing pain
- Medical/family history
- Current list of all drugs and supplements taken



# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #3

## ❖ Ongoing Assessment

- Before administering each dose of a cardiotonic, the nurse takes the apical pulse rate for 60 seconds and records it in the designated area on the chart or the medication administration record
- Pulse rate below 60 bpm and above 100 bpm in adults: withhold the drug and inform the primary healthcare provider
- For pediatric clients: withhold the drug if the child's pulse rate is below 70 bpm or below 90 bpm in an infant



# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #4

## ❖ Ongoing Assessment (continued)

- Weigh the client daily and measure intake and output
- Auscultate the lungs for crackles and assess for peripheral edema
- Assess serum electrolyte levels for signs of hypokalemia, hypomagnesemia, or hypercalcemia



# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #5

---

## ❖ Nursing Diagnosis

- Malnutrition Risk related to anorexia, nausea, vomiting
- Activity Intolerance related to weakness and drowsiness
- Injury Risk related to dizziness, lightheadedness

# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #6

## ❖ Planning

- Expected client outcomes depend on the reason for administration of the drug but include:
  - Optimal response to therapy
  - Management of adverse drug reactions
  - Confidence in an understanding of the prescribed medication regimen

# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #7

## ❖ Implementation

- Promoting Optimal Response to Therapy
  - Monitor serum levels of digoxin closely; drawn immediately before the next dose or 6 to 8 hours after the last dose (therapeutic levels = 0.8 to 2 ng/mL)
  - Monitor for signs of toxicity in frail elderly clients (toxicity = greater than 2 ng/mL)
  - Monitor periodic ECGs, serum electrolytes, and hepatic and renal function tests





# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #8

## ❖ Implementation

- Promoting Optimal Response to Therapy (continued)
  - Monitor clients on diuretics for hypokalemia
  - Monitor clients in the ICU for hypomagnesemia
  - When giving a cardiotonic via IV, administer slowly (over at least 5 minutes); assess administration site for redness and infiltration
  - Oral tablets and capsules can be given without regard to meals or fluids; tablets can be crushed and mixed with meals; do not alternate between capsules and tablets

# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #9

## ❖ Implementation

### ○ Monitoring and Managing Client Needs

#### ■ Malnutrition Risk

- Observation of the client for signs of digitalis toxicity such as anorexia, vomiting, and nausea
- Carefully consider any client complaint or comment, document, and report to provider
- If the nausea and anorexia is not resulting from toxicity, but from an adverse reaction to the drug, offer frequent small meals rather than large meals
- Restrict fluid at meals and 1 hour prior to meals
- Help the client maintain good oral hygiene

# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #10

## ❖ Implementation

### ○ Monitoring and Managing Client Needs

#### ■ Activity Intolerance

- Client may experience weakness and drowsiness as adverse reactions to digoxin
- Nurse plans a gradual increase in activities as tolerance increases and plans adequate rest periods throughout the day
- Nurse assists with activities and ambulation as necessary



# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #11

## ❖ Implementation

### ○ Potential Complication

#### ■ Digitalis Toxicity

- Observe for signs of digitalis toxicity and notify provider
  - GI: anorexia, nausea, vomiting, diarrhea
  - Muscular: weakness and lethargy
  - CNS: headache, drowsiness, visual disturbances, confusion, disorientation, delirium
  - Cardiac: changes in pulse rate or rhythm, ECG changes (bradycardia, tachycardia, premature ventricular contractions)

# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #12

## ❖ Implementation

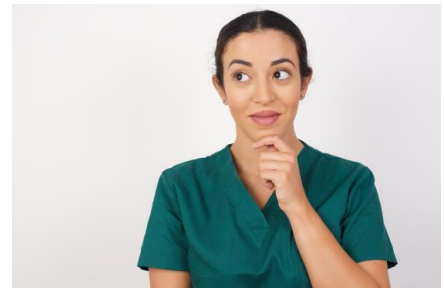
### ○ Potential Complication

#### ■ Digitalis Toxicity (continued)

- Digoxin toxicity can be successfully treated by simply withdrawing the drug
- If severe bradycardia develops, the provider may order atropine

## Pharmacology in Practice Exercise #3

- ❖ A client is being digitalized for heart failure. The primary healthcare provider assessing the client orders the analysis of serum electrolytes. Which of the following electrolyte changes indicated digoxin toxicity and needs to be reported? Select all that apply.
- a) Hyponatremia
  - b) Hypokalemia
  - c) Hypomagnesemia
  - d) Hypocalcemia
  - e) Hypophosphatemia



# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #13

## ❖ Implementation

### ○ Monitoring and Managing Client Needs

#### ■ Injury Risk

- Hypotension and bradycardia from cardiotonic and antiarrhythmic drugs can cause dizziness and lightheadedness; orthostatic hypotension can occur
- Client is at risk of falls
- Assist clients not on complete bed rest to ambulate until symptoms subside
- Advise client to make position changes slowly



# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #14

## ❖ Implementation—Educating the Client and Family

- The client and family must understand that the prescribed drug must be taken exactly as directed by the primary healthcare provider; same time each day; do not switch between caplets and tablets
- Show the client or a family member the correct technique for taking the pulse; take pulse before taking drug; do not take drug if pulse is less than 60 bpm or greater than 100 bpm





# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #15

## ❖ Implementation—Educating the Client and Family (continued)

- Teach the client to:
  - keep a log of pulses taken prior to drug administration
  - avoid nonprescription drugs unless their use has been approved by their provider
  - contact the provider if adverse reactions develop
  - carry medical identification describing disease process and drug regimen
  - follow dietary recommendations
  - use effective birth control (ivabradine)



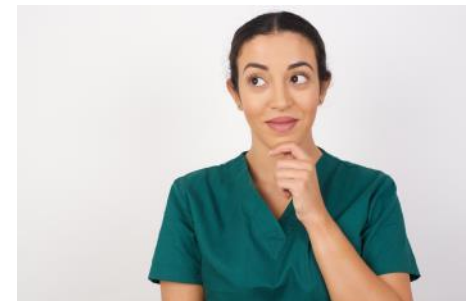
# Nursing Process—Client Receiving a Cardiotonic Drug—Digoxin #16

## ❖ Evaluation

- Was the therapeutic effect achieved and is the heart beating more effectively?
- Were adverse reactions: identified, reported, and managed?
  - Client maintains adequate nutrition status
  - Client carries out activities of daily living
  - No injury is evident
- Did client and family express confidence and demonstrate understanding of drug regimen?

# Turn and Talk—Case Study #1

- ❖ The physician orders a loading dose of digoxin 0.75 mg to be given intravenously, to a client hospitalized for heart failure. The digoxin is available in a solution of 0.5 mg/mL.
- 1. How many milliliters should the nurse prepare?
- 2. What should the nurse do before administering the IV dose?
- 3. If digoxin toxicity develops, what signs or symptoms might the client demonstrate?



## Turn and Talk—Case Study #2

- ❖ The physician orders a loading dose of digoxin 0.75 mg to be given intravenously, to a client hospitalized for heart failure. The digoxin is available in a solution of 0.5 mg/mL.
- 4. How often should the client be monitored for signs of digoxin toxicity?
- 5. What conditions might increase the client's likelihood of exhibiting digoxin toxicity?

