

Heart Failure

A decorative graphic consisting of a solid teal horizontal bar that transitions into a series of three thin, parallel white lines on the right side of the slide.

- Heart failure, cardiac failure, or pump failure results from the inability of the heart muscle to pump enough blood to supply the whole body.
- The different determinants of cardiac output such as heart rate, stroke volume, preload, and afterload are affected in heart failure.

Inability to pump sufficient blood results in:

1. Decreased tissue perfusion as evidenced by fatigue, weakness, and activity intolerance
2. Pulmonary and systemic congestion or volume overload as evidenced by jugular venous distention, peripheral edema, and dyspnea.

- Diuretics, ACE inhibitors, angiotensin II receptor blockers (ARBs), and beta adrenergic blockers are the medications of choice for treatment of heart failure. Cardiac glycosides are indicated if these medications are unable to control symptoms.

Cardiac Glycosides

- Select Prototype Medication: **digoxin** (Lanoxin, Lanoxicaps, and Digitek)

Expected Pharmacological Action

Positive inotropic effect = increased force of myocardial contraction

- Increased force and efficiency of myocardial contraction improves the heart's effectiveness as a pump, improving stroke volume and cardiac output.

Negative chronotropic effect = decreased heart rate

- At therapeutic levels, digoxin slows the rate of SA node depolarization and the rate of impulses through the conduction system of the heart.
- A decreased heart rate gives the ventricles more time to fill with blood coming from the atria, which leads to increased SV and increased CO.

Therapeutic Uses

- Treatment of heart failure
- Dysrhythmias (atrial fibrillation)

SIDE/ADVERSE EFFECTS	NURSING INTERVENTIONS/CLIENT EDUCATION
<ul style="list-style-type: none"> • Dysrhythmias (caused by interfering with the electrical conduction in the myocardium) • Cardiotoxicity leading to bradycardia 	<ul style="list-style-type: none"> • Conditions that increase the risk of developing digoxin-induced dysrhythmias include hypokalemia, increased serum digoxin levels, and heart disease. • Monitor serum levels of K⁺ to maintain a level between 3.5 to 5.0 mEq/L. • Instruct clients to report signs of hypokalemia (nausea/vomiting, general weakness). Potassium supplements may be prescribed if clients are concurrently taking a diuretic. • Teach clients to consume high-potassium foods (spinach, bananas, potatoes). • Monitor the client's digoxin level. <ul style="list-style-type: none"> ○ Therapeutic serum levels may vary, but usually range from 0.5 to 2.0 ng/mL. ○ Signs of toxicity may appear at levels less than 1.75 ng/mL. ○ Clients with heart failure respond best with serum medication levels between 0.5 to 0.8 ng/mL. ○ Dosages should be based on serum levels and client response to medication. • Teach clients to monitor pulse rate, and recognize and report changes. The rate may be irregular with early or extra beats noted.
<ul style="list-style-type: none"> • GI effects include anorexia (usually the first sign), nausea, vomiting, and abdominal pain. 	<ul style="list-style-type: none"> • Teach clients to monitor for these effects and report to the provider if they occur.
<ul style="list-style-type: none"> • CNS effects include fatigue, weakness, vision changes (diplopia, blurred vision, yellow-green or white halos around objects). 	<ul style="list-style-type: none"> • Teach clients to monitor for these effects and report to the provider if they occur.

Contraindications/Precautions

- Cardiac glycosides are Pregnancy Risk Category C.
- These agents are contraindicated in clients with disturbances in ventricular rhythm, including ventricular fibrillation, ventricular tachycardia, and second- and third-degree heart block.
- Use cautiously in clients who have hypokalemia, partial AV block, advanced heart failure, and renal insufficiency.

Interactions

MEDICATION/FOOD INTERACTIONS	NURSING INTERVENTIONS/CLIENT EDUCATION
<ul style="list-style-type: none"> Thiazide diuretics, such as hydrochlorothiazide (HCTZ), and loop diuretics, such as furosemide (Lasix), may lead to hypokalemia, which increases the risk of developing dysrhythmias 	<ul style="list-style-type: none"> Monitor K⁺ level and maintain between 3.5 to 5.0 mEq/L. Hypokalemia can be treated with potassium supplements or a potassium-sparing diuretic.
<ul style="list-style-type: none"> ACE inhibitors and ARBs increase the risk of hyperkalemia, which can lead to decreased therapeutic effects of digoxin. 	<ul style="list-style-type: none"> Use cautiously if these medications are used with potassium supplements or a potassium-sparing diuretic. Maintain K⁺ between 3.5 to 5.0 mEq/L.
<ul style="list-style-type: none"> Sympathomimetic medications such as dopamine (Intropin) complement the inotropic action of digoxin and increase the rate and force of heart muscle contraction. These medications may be beneficial, but also may increase the risk of tachydysrhythmias. 	<ul style="list-style-type: none"> Monitor ECG. Instruct clients to measure heart rate and report palpitations.
<ul style="list-style-type: none"> Quinidine increases the risk of digoxin toxicity when used concurrently. 	<ul style="list-style-type: none"> Avoid concurrent use.
<ul style="list-style-type: none"> Verapamil (Calan) increases plasma levels of digoxin. 	<ul style="list-style-type: none"> If used concurrently, digoxin dose should be decreased. Concurrent use is usually avoided because of verapamil cardiosuppression action counteracting the action of digoxin.

Nursing Administration

- Advise clients to take the medication as prescribed. If a dose is missed, the next dose should not be doubled.
- Check pulse rate and rhythm before administration of digoxin and record. Notify the provider if heart rate is less than 60/min in an adult, less than 70/min in children, and less than 90/min in infants.
- Administer digoxin at the same time daily.
- Monitor digoxin levels periodically during treatment and maintain therapeutic levels between 0.5 to 2.0 ng/mL to prevent digoxin toxicity.
- Avoid taking OTC medications to prevent adverse and side effects and medication interactions.
- Instruct clients to observe symptoms of hypokalemia, such as muscle weakness, and to notify the provider if symptoms occur.
- Instruct clients to observe symptoms of digoxin toxicity (anorexia, fatigue, weakness), and to notify the provider if symptoms occur.

Management of digoxin toxicity

- Digoxin and potassium-sparing medication should be stopped immediately.
- Monitor K⁺ levels. For levels less than 3.5 mEq/L, administer potassium intravenously or by mouth. Do not give any further K⁺ if the level is greater than 5.0 mEq/L.
- Treat dysrhythmias with phenytoin (Dilantin) or lidocaine.
- Treat bradycardia with atropine.
- For excessive overdose, activated charcoal, cholestyramine, or Digibind can be used to bind digoxin and prevent absorption.

Nursing Evaluation of Medication Effectiveness

Depending on therapeutic intent, effectiveness may be evidenced by:

- Control of heart failure signs and symptoms.
- Absence of cardiac dysrhythmias.

Adrenergic Agonists

Select Prototype Medication:

Catecholamines:

- Epinephrine (Adrenaline)
- Dopamine (Intropin)
- Dobutamine (Dobutrex)

Other Medications

- Isoproterenol: catecholamine
- Terbutaline: noncatecholamine

Purpose

RECEPTORS	SITE/RESPONSE
Alpha ₁	<ul style="list-style-type: none">• Activation of receptors in arterioles of skin, viscera and mucous membranes, and veins leads to vasoconstriction.
Beta ₁	<ul style="list-style-type: none">• Heart stimulation leads to increased heart rate, increased myocardial contractility, and increased rate of conduction through the AV node.• Activation of receptors in the kidney lead to the release of renin.
Beta ₂	<ul style="list-style-type: none">• Activation of receptors in the arterioles of the heart, lungs, and skeletal muscles leads to vasodilation.• Bronchial stimulation leads to bronchodilation.• Activation of receptors in uterine smooth muscle causes relaxation.• Activation of receptors in the liver cause glycogenolysis.• Skeletal muscle receptor activation leads to muscle contraction.
Dopamine	<ul style="list-style-type: none">• Activation of receptors in the kidney cause the renal blood vessels to dilate.

Therapeutic Use

RECEPTORS	PHARMACOLOGICAL ACTION	THERAPEUTIC USE
Epinephrine		
Alpha ₁	<ul style="list-style-type: none"> • Vasoconstriction 	<ul style="list-style-type: none"> • Slows absorption of local anesthetics • Manages superficial bleeding • Decreased congestion of nasal mucosa • Increased blood pressure
Beta ₁	<ul style="list-style-type: none"> • Increased heart rate • Increased myocardial contractility • Increased rate of conduction through the AV node 	<ul style="list-style-type: none"> • Treatment of AV block and cardiac arrest
Beta ₂	<ul style="list-style-type: none"> • Bronchodilation 	<ul style="list-style-type: none"> • Asthma

Dopamine

Low dose:
• Dopamine

- Renal blood vessel dilation

- Shock
- Heart failure

Moderate dose:
• Dopamine
• Beta₁

- Renal blood vessel dilation
- Increased heart rate
- Increased myocardial contractility
- Increased rate of conduction through the AV node

High dose:
• Dopamine
• Beta₁
• Alpha₁

- Renal blood vessel dilation
- Increased heart rate
- Increased myocardial contractility
- Increased rate of conduction through the AV node
- Vasoconstriction

Dobutamine

Beta₁

- Increased heart rate
- Increased myocardial contractility
- Increased rate of conduction through the AV node

- Heart failure

Side/Adverse Effects

SIDE/ADVERSE EFFECTS

NURSING INTERVENTIONS/CLIENT EDUCATION

Epinephrine

Vasoconstriction from activation of α_1 receptors in the heart can lead to hypertensive crisis.

- Provide for continuous cardiac monitoring.
- Report changes in vital signs to the provider.

Beta₁ receptor activation in the heart can cause dysrhythmias. Beta₁ receptor activation also increases the workload of the heart and increases oxygen demand leading to the development of angina.

- Provide for continuous cardiac monitoring.
- Monitor clients closely for dysrhythmias, change in HR and chest pain.
- Notify the provider of signs of dysrhythmias, increased heart rate and chest pain, and treat per protocol.

Dopamine

Beta₁ receptor activation in the heart can cause dysrhythmias. Beta₁ receptor activation also increases the workload of the heart and increases oxygen demand leading to development of angina.

- Provide for continuous cardiac monitoring.
- Monitor clients closely for dysrhythmias, change in HR, and chest pain.
- Notify the provider of signs of dysrhythmias, increased HR, and chest pain, and treat per protocol.

Necrosis can occur from extravasation of high doses of dopamine.

- Monitor IV site carefully.
- Discontinue infusion at first sign of irritation.

Dobutamine

Increased HR

- Provide for continuous cardiac monitoring.
- Report changes in vital signs to the provider.

Contraindications/Precautions

- Epinephrine and dopamine are Pregnancy Risk Category C.
- Dobutamine is Pregnancy Risk Category B.
- These medications are contraindicated in clients who have tachydysrhythmias and ventricular fibrillation.
- Use cautiously in clients who have hyperthyroidism, angina, history of myocardial infarction, hypertension, and diabetes.

Interactions

MEDICATION/FOOD INTERACTIONS	NURSING INTERVENTIONS/CLIENT EDUCATION
MAOIs prevent inactivation of epinephrine and therefore prolong the effects of epinephrine.	<ul style="list-style-type: none">• Avoid use of MAOIs in clients receiving epinephrine.
Tricyclic antidepressants block uptake of epinephrine, which will prolong and intensify effects of epinephrine.	<ul style="list-style-type: none">• Clients taking these medications concurrently may need a lowered dosage of epinephrine.
General anesthetics can cause the heart to become hypersensitive to the effects of epinephrine, leading to dysrhythmias.	<ul style="list-style-type: none">• Perform continuous ECG monitoring.• Notify the provider of signs of chest pain, dysrhythmias, and increased heart rate.
Alpha-adrenergic blocking agents, such as phentolamine, block action at alpha receptors.	<ul style="list-style-type: none">• Phentolamine may be used to treat epinephrine toxicity.
Beta-adrenergic blocking agents, such as propranolol block action at beta receptors.	<ul style="list-style-type: none">• Propranolol may be used to treat chest pain and dysrhythmias.
Diuretics promote beneficial effects of dopamine.	<ul style="list-style-type: none">• Monitor for therapeutic effects.

Nursing Administration

- This medication must be administered IV by continuous infusion.
- Use an IV pump to control infusion.
- Dosage is titrated based on blood pressure response.
- Stop the infusion at first evidence of infiltration. Extravasation can be treated with local injection of an alpha-adrenergic blocking agent, such as phentolamine.
- Assess/monitor clients for chest pain. Notify the provider if chest pain occurs.
- Provide continuous ECG monitoring. Notify the provider of signs of tachycardia or dysrhythmias.

Nursing Evaluation of Medication Effectiveness

Depending on therapeutic intent, effectiveness may be evidenced by:

- Improved perfusion as evidenced by urine output of > 30 mL/hr (with normal renal function), improved mental status, and systolic blood pressure maintained at > 90 mm Hg.