chapter 22

# Adrenergic Drugs

## Key Terms

*autonomic nervous system*
*central nervous system*
*neurotransmitter*
*parasympathetic nervous system*
*peripheral nervous system*
*shock*
*somatic nervous system*
*sympathetic nervous system*
*vasopressor*

## Chapter Objectives

*On completion of this chapter, the student will:*

- Discuss the activity of the central nervous system and the peripheral nervous system.
- Discuss the types of shock, physiologic responses of shock, and the use of adrenergic drugs in the treatment of shock.
- Discuss the uses, general drug actions, contraindications, precautions, interactions, and adverse reactions associated with the administration of adrenergic drugs.
- Discuss important preadministration and ongoing assessment activities the nurse should perform on the patient taking adrenergic drugs.
- List some nursing diagnoses particular to a patient taking the adrenergic drugs.
- Discuss ways to promote an optimal response to therapy, how to manage common adverse reactions, and important points to keep in mind when educating patients about the use of adrenergic drugs.

The adrenergic drugs produce pharmacologic effects similar to the effects that occur in the body when the adrenergic nerves and the medulla are stimulated. The primary effects of these drugs occur on the heart, the blood vessels, and the smooth muscles, such as the bronchi. A basic knowledge of the nervous system is necessary to understand these drugs and how they work in the body.

## THE NERVOUS SYSTEM

The nervous system is a complex part of the human body concerned with the regulation and coordination of body activities such as movement, digestion of food, sleep, and elimination of waste products. The nervous system has two main divisions: the central nervous system (CNS) and the peripheral nervous system (PNS). Figure 22-1 illustrates the divisions of the nervous system.

The **CNS** consists of the brain and the spinal cord and receives, integrates, and interprets nerve impulses. The PNS is the term used to describe all nerves outside of the brain and spinal cord. The PNS connects all parts of the body with the CNS.

### Peripheral Nervous System

The **PNS** is further divided into the somatic nervous system and the autonomic nervous system. The somatic branch of the PNS is concerned with sensation and voluntary movement. The sensory part of the **somatic nervous system** sends messages to the brain concerning the internal and external environment, such as sensations of heat, pain, cold, and pressure. The voluntary part of the somatic nervous system is concerned with the voluntary movement of skeletal muscles, such as walking, chewing food, or writing a letter.

#### *Autonomic Branch of the Peripheral Nervous System*

The autonomic branch of the PNS is concerned with functions essential to the survival of the organism. Functional activity of the **autonomic nervous system**

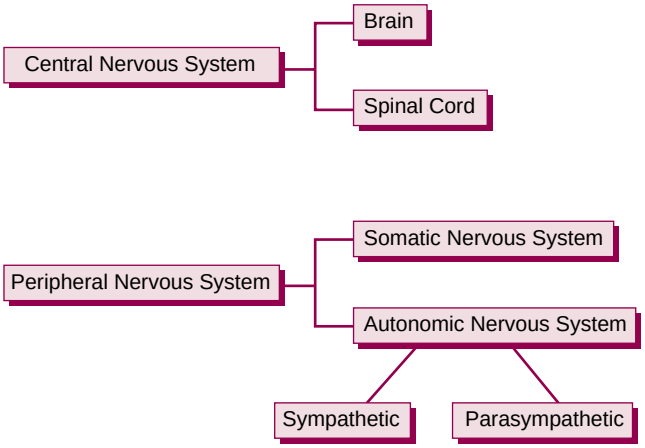


**FIGURE 22-1.** The nervous system.

is not consciously controlled (ie, the activity is automatic). This system controls blood pressure, heart rate, gastrointestinal activity, and glandular secretions. Table 22-1 describes the action of the autonomic nervous system on the body.

The autonomic nervous system is divided into the sympathetic and the parasympathetic nervous system. The **sympathetic nervous system** tends to regulate the expenditure of energy and is operative when the organism is confronted with stressful situations, such as danger, intense emotion, or severe illness. The **parasympathetic nervous system** helps conserve body energy and is partly responsible for such activities as slowing the heart rate, digesting food, and eliminating body wastes.

## Neurotransmitters

**Neurotransmitters** are chemical substances called neurohormones. These are released at the nerve endings that facilitate the transmission of nerve impulses. The two neurohormones (neurotransmitters) of the sympathetic nervous system are epinephrine and norepinephrine. Epinephrine is secreted by the adrenal medulla. Norepinephrine is secreted mainly at nerve endings of sympathetic (also called adrenergic) nerve fibers (Fig. 22-2).

# ADRENERGIC DRUGS

Adrenergic drugs mimic the activity of the sympathetic nervous system. These drugs also are called sympathomimetic drugs. Epinephrine and norepinephrine are neurohormones produced naturally by the body. Synthetic preparations of these two neurohormones, which are identical to those naturally produced by the body, are used in medicine. Adrenergic drugs such as metaraminol (Aramine), isoproterenol (Isuprel), and ephedrine are synthetic adrenergic drugs.

## ACTIONS

Generally, adrenergic drugs produce one or more of the following responses in varying degrees:

- CNS—wakefulness, quick reaction to stimuli, quickened reflexes
- PNS—relaxation of the smooth muscles of the bronchi; constriction of blood vessels, sphincters of the stomach; dilatation of coronary blood vessels; decrease in gastric motility
- Heart—increase in the heart rate
- Metabolism—increased use of glucose (sugar) and liberation of fatty acids from adipose tissue

## Adrenergic Nerve Receptors

Adrenergic nerve fibers have either alpha (α) or beta (β) receptors. Adrenergic drugs may act on α receptors only, β receptors only, or on both α and β receptors. For example, phenylephrine (Neo-Synephrine) acts chiefly on α receptors; isoproterenol acts chiefly on β receptors; and epinephrine acts on both α and β receptors. Whether an adrenergic drug acts on α, β, or α and β receptors accounts for the variation of responses for this group of drugs. See Table 22-1 for a list of the type of adrenergic nerve fiber receptors that corresponds with each action of the autonomic nervous system on the body.

The α and β receptors can be further divided into $\alpha_1$- and $\alpha_2$-adrenergic receptors and $\beta_1$- and $\beta_2$-adrenergic

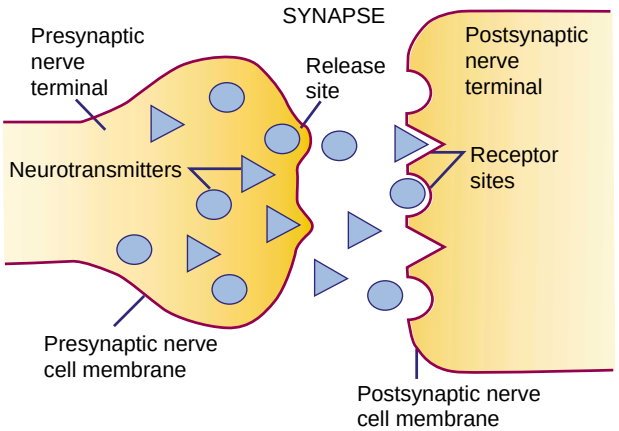


**FIGURE 22-2.** Neurotransmission in the central nervous system. Neurotransmitter molecules (eg, norepinephrine), released by the presynaptic nerve, cross the synapse and bind with receptors in the cell membrane of the postsynaptic nerve, resulting in the transmission of the nerve impulse.

**TABLE 22-1 Action of the Autonomic Nervous System on Body Organs and Structures**

| ORGANS OR STRUCTURES | SYMPATHETIC (ADRENERGIC) EFFECTS | TYPES OF SYMPATHETIC (ADRENERGIC) RECEPTOR | PARASYMPATHETIC (CHOLINERGIC) EFFECTS |
|---|---|---|---|
| Heart | Increase in heart rate, heart muscle contractility, increase in speed of atrioventricular conduction | β | Decrease in heart rate, decrease in heart muscle contractility |
| Blood vessels | | | |
| 1. Skin, mucous membranes | Constriction | α | |
| 2. Skeletal muscle | Usually dilatation | Cholinergic, *β | |
| Bronchial muscles | Relaxation | β | Contraction |
| Gastrointestinal | | | |
| 1. Muscle motility, tone decrease | | β | Increase |
| 2. Sphincters | Usually contraction | α | Usually relaxation |
| 3. Gallbladder | Relaxation | | Contraction |
| Urinary bladder | | | |
| 1. Detrusor muscle | Relaxation | β | Contraction |
| 2. Trigone, sphincter muscles | Contraction | α | Relaxation |
| Eye | | | |
| 1. Radial muscle of iris | Contraction (pupil dilates) | α | |
| 2. Sphincter muscle of iris | | | Contraction (pupil constricts) |
| 3. Ciliary muscle | | | Contraction |
| Skin | | | |
| 1. Sweat glands | Increased activity in localized areas | Cholinergic* | |
| 2. Pilomotor muscles | Contraction (gooseflesh) | α | |
| Uterus | Relaxation | β | |
| Salivary glands | Thickened secretions | α | Copious, watery secretions |
| Liver | Glycogenolysis | β | |
| Lacrimal and nasopharyngeal glands | | | Increased secretion |
| Male sex organs | Emission | α | Erection |

*Cholinergic transmission, but nerve cell chain originates in the thoracolumbar part of the spinal cord and is therefore sympathetic. alpha, α; beta, β.

receptors. Table 22-2 indicates the effects in the body when stimulation of these receptors occurs.

## USES

Adrenergic drugs have a wide variety of uses and may be given as all or part of the treatment for:

- Hypovolemic and septic shock;
- Moderately severe to severe episodes of hypotension;
- Control of superficial bleeding during surgical and dental procedures of the mouth, nose, throat, and skin;
- Bronchial asthma;
- Cardiac decompensation and arrest;
- Allergic reactions (anaphylactic shock, angioneurotic edema);
- Temporary treatment of heart block;
- Ventricular arrhythmias (under certain conditions);
- Nasal congestion (applied topically); and
- In conjunction with local anesthetics to prolong anesthetic action in medicine and dentistry.

Other adrenergic drugs have specific uses. Isoproterenol may be used in the treatment of some cardiac arrhythmias, cardiac arrest, Adams-Stokes syndrome, or as a systemic bronchodilator (see Chap. 37 for a more detailed discussion of the bronchodilators). Midodrine is used to treat orthostatic hypotension. The uses of various adrenergic drugs are given in the Summary Drug Table: Adrenergic Drugs.

## SUMMARY DRUG TABLE ADRENERGIC DRUGS

| GENERIC NAME | TRADE NAME* | USES | ADVERSE REACTIONS | DOSAGE RANGES |
|---|---|---|---|---|
| dobutamine HCL *doe'-byoo-ta-meen* | Dobutrex, *generic* | Cardiac decompensation due to depressed contractility caused by organic heart disease or cardiac surgical procedures | Headache, nausea, increased heart rate, increase in systolic blood pressure, palpitations, anginal and nonspecific chest pain | 2.5–15 mcg/kg/min IV (up to 40 mcg/kg/min); titrate to patient's hemodynamic and renal status |
| dopamine *doe'-pa-meen* | Intropin, *generic* | Shock due to MI, trauma, open-heart surgery, renal failure, and chronic cardiac decompensation in CHF | Nausea, vomiting, ectopic beats, tachycardia, anginal pain, palpitations, hypotension, dyspnea | 2–50 mcg/kg/min IV (infusion rate determined by patient's response) |
| ephedrine sulfate *e-fed'-rin* | *generic* | Hypotension, relief of acute bronchospasm, allergic disorders, nasal and nasopharyngeal mucosal congestion, adjunctive treatment of middle ear infection | Anxiety, insomnia, tenseness, restlessness, headache, light-headedness, dizziness, nausea, dysuria, pallor - | Hypotension and allergic disorders, asthma: 25/mg–50 mg IM, SC, or IV; topical nasal decongestant: instill in each nostril q4h |
| epinephrine *ep-i-nef'-rin* | Adrenalin chloride, AsthmaHaler, Bronkaid, *generic* | Ventricular standstill; treatment and prophylaxis of cardiac arrest, heart block; muscosal congestion of hay fever, rhinitis, and acute sinusitis; relief of bronchial asthmatic paroxysms; simple open-angle glaucoma | Anxiety, insomnia, tenseness, restlessness, headache, light-headedness, dizziness, nausea, dysuria, pallor | Cardiac arrest: 0.5–1.0 mg IV; respiratory distress (eg, asthma, anaphylaxis): 0.3–0.5 mL of 1:1000 solution, SC or IM q20 min for 4h or 0.1–0.3 mL/SC of 1:200 suspension; 1 inhalation q3h; 1–3 deep inhalation by nebulizer 4–6 times/day; ophthalmic, 1–2 gtts times daily |
| isoproterenol *eye-sew-proe-tear'-e-nall* | Isuprel, Medihaler-Iso | Injection: shock, bronchospasm during anesthesia, cardiac standstill and arrhythmias Inhalation: acute bronchial asthma, emphysema, bronchitis, bronchiectasis | Anxiety, insomnia, tenseness, restlessness, headache, light-headedness, dizziness, nausea, dysuria, pallor, pulmonary edema | Injection shock: 2 mcg/mL diluted solution IV; bronchospasm during anesthesia: 0.01–0.02 mg of diluted solution IV; cardiac arrhythmias, cardiac standstill: 0.02–0.06 mg of diluted solution IV, 5 μg/min IV infusion; 0.2 mg of undiluted 1:5000 solution IM, SC; inhalation bronchial spasm: hand bulb nebulizer 1:200 solution 5–15 deep inhalations or 1:100 solution in 3–7 inhalations; for metered-dose inhaler, 1–2 inhalations 4–6 times a day |
| levalbuterol *lev-al-byoo'-ter-ole* | Xopenex | Treatment or prevention of bronchospasm in adults and adolescents 12 years and older with reversible obstructive airway disease | Restlessness, apprehension, anxiety, fear, CNS stimulation, cardiac arrhythmias, sweating, pallor, flushing, nausea | 0.63–1.25 mg TID by nebulization |

## SUMMARY DRUG TABLE ADRENERGIC DRUGS *(Continued)*

| GENERIC NAME | TRADE NAME* | USES | ADVERSE REACTIONS | DOSAGE RANGES |
|---|---|---|---|---|
| metaraminol *met-a-ram-i-nole* | Aramine | Hypotension with spinal anesthesia, hypotension due to hemorrhage, drug reactions, surgical complication, shock associated with brain damage | Headache, flushing sinus or ventricular tachycardia, arrhythmias, nausea, apprehension, palpitation | 2–10 mg IM, SC; 15–100 mg in 250– or 500–mL solution IV |
| midodrine *mid'-oh-dryn* | ProAmatine | Orthostatic hypotension | Paresthesias, headache, pain, dizziness, supine hypertension, bradycardia, piloerection, pruritus, dysuria, chills | 10 mg PO TID during daylight hours when upright |
| norepinephrine *nor-ep-i-nef'-rin* (levarterenol) | Levophed | Shock, hypotension, cardiac arrest | Restlessness, headache, dizziness, bradycardia, hypertension | 1 mg/mL in 1000 mL 5% dextrose solution, 2–3 mL/min IV, rate adjusted to maintain desired blood pressure; average dose, 2–4 μg/min |

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

## Shock

The adrenergic drugs are important in the care and treatment of patients in shock. **Shock** is defined as a life-threatening condition of inadequate perfusion. In shock, there is an inadequate supply of arterial blood flow and oxygen delivery to the cells and tissues. The body initiates compensatory mechanisms to counteract the symptoms of shock (eg, the release of epinephrine and norepinephrine). In some situations, the body is able to compensate and blood pressure is maintained. However, if shock is untreated and compensatory mechanisms of the body fail, irreversible shock occurs and death follows. There are five types of shock: hypovolemic shock, cardiogenic shock, septic shock, obstructive shock, and neurogenic shock. Table 22-3 describes the various types of shock.

Various clinical manifestations may be present in a patient in shock. For example, in the early stages of shock the extremities may be warm because compensatory mechanisms are initiated and the blood flow to the skin and extremities is maintained. If the condition is untreated, the skin and extremities become cool and clammy because of the failure of the compensatory mechanisms and the progression of shock. Thus, more advanced shock may be referred to as

## TABLE 22-2 Effects of the Adrenergic Receptors

| RECEPTOR | SITE | EFFECT |
|---|---|---|
| $\alpha_1$ | Peripheral blood vessels | Vasoconstriction of peripheral blood vessels |
| $\alpha_2$ | Presynaptic neuron | Regulates release of neurotransmitters; decreases tone, motility, and secretions of gastrointestinal tract |
| $\beta_1$ | Myocardium | Increased heart rate, increased force of myocardial contraction |
| $\beta_2$ | Peripheral blood vessels | Vasodilation of peripheral vessels |
| | Bronchial smooth muscles | Bronchodilation |

alpha, α; beta, β.

**TABLE 22-3 Types of Shock**

| TYPE* | DESCRIPTION |
|---|---|
| Hypovolemic | Occurs when the volume of extracellular fluid is significantly diminished. Examples include hemorrhage, fluid loss caused by burns, diarrhea, vomiting, or excess diuresis |
| Cardiogenic | Occurs when the heart is unable to deliver an adequate cardiac output to maintain perfusion to the vital organs. Examples include: as the result of an acute myocardial infarction, ventricular arrhythmias, congestive heart failure (CHF), or severe cardiomyopathy. |
| Septic | Occurs as a result of circulatory insufficiency associated with overwhelming infection |
| Obstructive | Occurs when obstruction of blood flow results in inadequate tissue perfusion. Examples include a severe reduction of blood flow as the result of massive pulmonary embolism, pericardial tamponade, restrictive pericarditis, and severe cardiac valve dysfunction |
| Neurogenic | Occurs as a result of blockade of neurohumoral outflow. Examples include: from a pharmacological source (ie, spinal anesthesia) or direct injury to the spinal cord. This type of shock is rare. |

*Other causes of shock include anaphylaxis, hypoglycemia, hypothyroidism, or Addison's disease.

"cool" or "cold" shock. Regardless of the type, shock results in a decrease in cardiac output, decrease in arterial blood pressure (hypotension), reabsorption of water by the kidneys (causing a decrease in urinary output), decrease in the exchange of oxygen and carbon dioxide in the lungs, increase in carbon dioxide in the blood and decrease in oxygen in the blood, hypoxia (decreased oxygen reaching the cells), and increased concentration of intravascular fluid. This scenario compromises the functioning of vital organs such as the heart, brain, and kidneys. The various physiologic responses caused by shock within the body are listed in Table 22-4.

The adrenergic drugs are useful in improving hemodynamic status by improving myocardial contractility and increasing heart rate, which results in increased cardiac output. Peripheral resistance is increased by vasoconstriction. In cardiogenic shock or advanced shock associated with low cardiac output, the adrenergic drug may be used with a vasodilating drug. A vasodilator such as nitroprusside (Chap. 42) or nitroglycerin (Chap. 41) improves myocardial performance as the adrenergic drug maintains blood pressure.

**TABLE 22-4 Physiologic Manifestations of Shock**

| BODY SYSTEM | POSSIBLE SIGNS AND SYMPTOMS |
|---|---|
| Integumentary (skin) | Pallor, cyanosis, cold and clammy, sweating |
| Central nervous system | Agitation, confusion, disorientation, coma |
| Cardiovascular | Hypotension, tachycardia, arrhythmias, wide pulse pressure, gallop rhythm |
| Respiratory | Tachypnea, pulmonary edema |
| Renal | Urinary output $< 20$ mL/h |
| Metabolic | Acidosis |

## ADVERSE REACTIONS

The adverse reactions associated with the administration of adrenergic drugs depend on the drug used, the dose administered, and individualized patient response. Some of the more common adverse reactions include cardiac arrhythmias, such as bradycardia and tachycardia, headache, insomnia, nervousness, anorexia, and an increase in blood pressure (which may reach dangerously high levels). Additional adverse reactions for specific adrenergic drugs are listed in the Summary Drug Table: Adrenergic Drugs.

## CONTRAINDICATIONS

Adrenergic drugs are contraindicated in patients with known hypersensitivity. Isoproterenol is contraindicated in patients with tachyarrhythmias, tachycardia or heart block caused by digitalis toxicity, ventricular arrhythmias, and angina pectoris. Dopamine is contraindicated in those with pheochromocytoma (tumor of adrenal gland), unmanaged arrhythmias, and ventricular fibrillation. Epinephrine is contraindicated in patients with narrow-angle glaucoma, cerebral arteriosclerosis, and cardiac insufficiency. Norepinephrine and ephedrine are contraindicated in patients who are hypotensive from blood volume deficits. Midodrine is contraindicated in those with severe organic heart disease, acute renal disease, pheochromocytoma, and supine hypertension.

## PRECAUTIONS

These drugs are used cautiously in patients with coronary insufficiency, cardiac arrhythmias, angina pectoris, diabetes, hyperthyroidism, occlusive vascular disease, or prostatic hypertrophy, and in those taking digoxin. Patients with diabetes may require an increased dosage of insulin. Epinephrine is used cautiously in patients with Parkinson's disease (may temporarily increase rigidity and tremor) or ventricular fibrillation and in the elderly. Ephedrine is used cautiously in patients with acute-closure glaucoma. Midodrine is used cautiously in patients with urinary problems or hepatic disease and during lactation. Adrenergic drugs are classified as Pregnancy Category C and are used with extreme caution during pregnancy.

## INTERACTIONS

There is an increased risk of hypertension when dobutamine is administered with the β-adrenergic blocking drugs. When dopamine is administered with the monoamine oxidase inhibitors (see Chap. 31) or the tricyclic antidepressants (see Chap. 31), there is a risk for increased effects of dopamine. There is an increased risk of seizures, hypotension, and bradycardia when dopamine is administered with phenytoin. When epinephrine is administered with the tricyclic antidepressants, there is an increased risk of sympathomimetic effects. Excessive hypertension can occur when epinephrine is administered with propranolol. A decreased bronchodilating effect occurs when epinephrine is administered with the β-adrenergic drugs. Metaraminol is used cautiously in patients taking digoxin because of an increased risk for cardiac arrhythmias. When midodrine is administered with cardiac glycosides, psychotropic drugs, or β blockers, bradycardia, heart block, or arrhythmias can occur.

## NURSING PROCESS

### The Patient Receiving an Adrenergic Drug

#### ASSESSMENT

Assessment of the patient receiving an adrenergic drug differs depending on the drug, the patient, and the reason for administration. For example, assessment of the patient in shock who is to be treated with norepinephrine is different from that for the patient receiving nose drops containing phenylephrine. Both are receiving adrenergic drugs, but the circumstances are much different.

### Herbal Alert: Ephedra

*Many members of the Ephedra family have been used medicinally (ie, E. sinica* and *E. intermedia). Ephedra preparations have traditionally been used to relieve cold symptoms, improve respiratory function, as an adjunct in weight loss, and to treat a variety of conditions from headaches to sexually transmitted disease. Large doses may cause a variety of adverse reactions, such as hypertension, irregular heart rate, tremors, epigastric pain, nausea, vomiting, sweating, weakness, and possible dependence. Ephedra is contraindicated in patients with hypertension, glaucoma, hypertrophy of the prostate, urinary tract problems, clotting disorders, anxiety, anorexia, colitis, thyroid disease, or diabetes. Ephedra should not be used with the cardiac glycosides, halothane, guanethidine, MAOIs, oxytocin, and in patients taking St. John's wort. Weight loss preparations containing ephedra should be avoided.*

*Before taking this herb the patient should consult the primary care provider. When taking a standardized extract, 12 to 25 mg total alkaloids (calculated as ephedrine) two to three times daily is the normal dosage. When taking the capsules or tablets, the normal dosage is 500 to 1000 mg two to three times daily.*

*The FDA warns the public not to take ephedrine-containing dietary supplements with labels that portray the products as an alternative to illegal street drugs such as Ecstasy because these products may pose serious health risks to consumers.*

#### *Preadministration Assessment*

When a patient is to receive an adrenergic agent for shock, the nurse obtains the blood pressure, pulse rate and quality, and respiratory rate and rhythm. The nurse assesses the patient's symptoms, problems, or needs before administering the drug and records any subjective or objective data on the patient's chart. In emergencies, the nurse must make assessments quickly and accurately. This information provides an important database that is used during treatment.

A general survey of the patient also is necessary. It is important to look for additional symptoms of shock, such as cool skin, cyanosis, diaphoresis, and a change in the level of consciousness. Other assessments may be necessary if the hypotensive episode is due to trauma, severe infection, or blood loss.

In patients taking midodrine for orthostatic hypotension, the nurse checks the blood pressure with the patient supine and sitting before therapy is begun. This is important because midodrine is contraindicated in patients with supine hypertension.

When a patient is to have nose drops instilled for nasal congestion, the nurse examines the nasal passages and describes the type of secretions present in the nose. The nurse also should obtain the blood pressure because nose drops that contain adrenergic drugs are not given to those with high blood pressure.

**Nursing Diagnoses Checklist**

- ☑ **Ineffective Tissue Perfusion** related to hypovolemia, blood loss, impaired distribution of fluid, impaired circulation, impaired transport of oxygen across alveolar and capillary bed, other (specify)
- ☑ **Decreased Cardiac Output** related to altered heart rate and/or rhythm
- ☑ **Imbalanced Nutrition: Less Than Body Requirements** related to adverse reaction (anorexia) to the drug
- ☑ **Disturbed Sleep Pattern** related to adverse reactions (insomnia, nervousness) to the drug

### *Ongoing Assessment*

During the ongoing assessment, the nurse observes the patient for the effect of the drug, such as improved breathing of the patient with asthma, response of the blood pressure to the administration of the vasopressor, or controlled orthostatic hypotension. During therapy, the nurse evaluates and documents the drug effect. The nurse also takes and documents the vital signs. Comparison of assessments made before and after administration may help the primary health care provider determine future use of the drug for this patient. It is important to report adverse drug reactions to the primary health care provider as soon as possible.

## 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 will depend on the reason for administration of an adrenergic agent but may include an optimal response to drug therapy, management of common adverse reactions, an absence of infection, and an understanding of the reason the drug is being given.

## IMPLEMENTATION

### *Promoting an Optimal Response to Therapy*

Management of the patient receiving an adrenergic agent varies and depends on the drug used, the reason for administration, and the patient's response to the drug. In most instances, adrenergic drugs are potent and potentially dangerous. The nurse must exercise great care in the calculation and preparation of these drugs for administration. Although adrenergic drugs are potentially dangerous, proper supervision and management before, during, and after administration will minimize the occurrence of any serious problems. Management of shock is aimed at providing basic life support (airway, breathing, and circulation) while attempting to correct the underlying cause. Antibiotics, inotropes, hormones (eg, insulin, thyroid), and other drugs may be used to treat the underlying disease. However, the initial pharmacologic intervention is aimed at supporting the circulation with vasopressors.

MAINTAINING ADEQUATE TISSUE PERFUSION. When a patient is in shock and experiencing ineffective tissue perfusion there is a decrease in oxygen resulting in an inability of the body to nourish its cells at the capillary level. If the patient has marked hypotension the administration of a **vasopressor** (a drug that raises the blood pressure because of its ability to constrict blood vessels) is required. The primary health care provider determines the cause of the hypotension and then selects the best method of treatment. Some hypotensive episodes require the use of a less potent vasopressor, such as metaraminol, whereas at other times a more potent vasopressor, such as dobutamine (Dobutrex), dopamine (Intropin), or norepinephrine (Levophed) is necessary.

The nurse considers the following points when administering the potent vasopressors dopamine and norepinephrine:

- Use an electronic infusion pump to administer these drugs.
- Do not mix dopamine with other drugs, especially sodium bicarbonate or other alkaline intravenous (IV) solutions. Check with the hospital pharmacist before adding a second drug to an IV solution containing this drug.
- Administer norepinephrine and dopamine only via the IV route. Do not dilute these drugs in an IV solution before administration. The primary health care provider orders the IV solution, the amount of drug added to the solution, and the initial rate of infusion.
- Monitor blood pressure every 2 minutes from the beginning of therapy until the desired blood pressure is achieved, then monitor the blood pressure and pulse rate at frequent intervals, usually every 5 to 15 minutes, during the administration of these drugs.
- Adjust the rate of administration according to the patient's blood pressure. The rate of administration of the IV solution is increased or decreased to maintain the patient's blood pressure at the systolic level ordered by the primary health care provider.
- Readjustment of the rate of flow of the IV solution is often necessary. The frequency of adjustment will depend on the patient's response to the vasopressor.
- Inspect the needle site and surrounding tissues at frequent intervals for leakage (extravasation, infiltration) of the solution into the subcutaneous tissues surrounding the needle site. If either situation occurs, establish another IV line immediately, discontinue the IV containing the vasopressor, and

notify the primary health care provider. These drugs are particularly damaging to the tissues if leakage into the surrounding tissue occurs. The nurse should keep phentolamine nearby to use when extravasation occurs. The affected area is infiltrated with 5 to 10 mg of phentolamine in 10 to 15 mL of saline.

- Never leave the patient receiving these drugs unattended.

Monitoring the patient in shock requires vigilance on the part of the nurse. The patient's heart rate, blood pressure, and ECG are monitored continuously. The urinary output is measured often (usually hourly), and an accurate intake and output is taken. Monitoring of central venous pressure via a central venous catheter will provide an estimation of the patient's fluid status. Sometimes additional hemodynamic monitoring is necessary with a pulmonary artery catheter. The use of a pulmonary artery catheter allows the nurse to monitor a number of parameters, such as cardiac output and peripheral vascular resistance. The nurse adjusts therapy according to the primary health care provider's instructions.

The less potent vasopressors, such as metaraminol, also require close patient supervision during administration. The nurse follows the same procedure as that for norepinephrine and dopamine but may take blood pressure and pulse determinations at less frequent intervals, usually every 15 to 30 minutes. The nurse needs sound clinical judgment to determine the frequency because there is no absolute minimum or maximum time limit between determinations.

MAINTAINING CARDIAC OUTPUT. The heart rate and stroke volume determine cardiac output. The stroke volume is determined in part by the contractile state of the heart and the amount of blood in the ventricle available to be pumped out. The interventions listed above help to support the cardiac output of the patient in shock.

It is important for the nurse to monitor vital signs carefully when the patient is in shock. The nurse monitors the vital signs (heart rate and rhythm, respiratory rate, and blood pressure) often (every 15 to 30 minutes) to determine the severity of shock. For example, as cardiac output decreases, compensatory tachycardia develops to increase cardiac output. As shock deepens, the pulse volume becomes progressively weaker and assumes a "thready" feel. The heart rate increases and the heart rhythm may become irregular. Initially the respiratory rate is rapid as the patient experiences air hunger, but in profound shock the respiratory rate decreases. Blood pressure decreases as shock progresses.

CARING FOR THE PATIENT TAKING MIDODRINE. This drug is administered only when the patient is out of bed. Bedridden patients should not receive the drug. The patient taking midodrine will need frequent monitoring of blood pressure and heart rate. Bradycardia is common at the beginning of therapy. Persistent bradycardia should be reported to the primary health care provider for evaluation. Because the drug can cause dysuria, the patient is asked to void before administration of the drug.

### Nursing Alert

*Regardless of the actual numerical reading of the blood pressure, a progressive fall of the blood pressure is serious. The nurse reports to the primary health care provider any progressive fall of the blood pressure, a fall in systolic blood pressure below 100 mm Hg, or any fall of 20 mm Hg or more of the patient's normal blood pressure.*

### *Monitoring and Managing Adverse Reactions*

The nurse reports and documents any complaint the patient may have while taking the adrenergic drugs. However, nursing judgment is necessary when reporting adverse reactions. The nurse must report some adverse effects, such as the development of cardiac arrhythmias immediately, regardless of the time of day or night. The nurse should report other adverse effects, such as anorexia, but this is usually not an emergency.

### Nursing Alert

*Supine hypertension is a potentially dangerous adverse reaction when taking midodrine. The nurse can minimize this reaction by administering the medication during the day while the patient is in an upright position. Keeping the patient in an upright position can sometimes control supine hypertension. This requires that the patient sleep with the head of the bed elevated.*

*The following is a suggested dosing schedule for the administration of midodrine: shortly before arising in the morning, midday, and late afternoon (not after 6:00 PM). The nurse should continue drug therapy only in the patient whose orthostatic hypotension improves during the initial treatment.*

### Gerontologic Alert

*The older adult is particularly vulnerable to adverse reactions of the adrenergic drugs, particularly epinephrine. In addition, older adults are more likely to have preexisting cardiovascular disease that predisposes them to potentially serious cardiac arrhythmias. The nurse closely monitors all elderly patients taking an adrenergic drug. It is important to report any changes in the pulse rate or rhythm immediately. In addition, epinephrine may temporarily increase tremor and rigidity in older adults with Parkinson's disease.*

MAINTAINING ADEQUATE TISSUE PERFUSION AND CARDIAC OUTPUT. Administration of an adrenergic drug may cause hypertension or tachycardia. These adverse reactions may cause a decrease in oxygenation at the cellular level. It is important for the nurse to monitor the pulse and blood pressure during the administration of an adrenergic drug. If the patient is being given the adrenergic drug for hypotension, there is already a potential problem with tissue perfusion. Administration of the adrenergic drug may correct the problem or, if the blood pressure becomes too high, tissue perfusion may again be a problem. Maintaining the blood pressure at the systolic rate prescribed by the primary health care provider will maintain tissue perfusion. If the pulse rate increases to a rate of 100 bpm or more or a change in rhythm occurs, the primary health care provider is notified.

**Nursing Alert**

*Prolonged high-dose therapy of the adrenergic drugs can produce cyanosis and tissue necrosis of distal extremities. It is important to remember to use the lowest possible dose that produces an adequate response for the shortest period of time. The nurse monitors the patient's extremities closely for any signs of cyanosis.*

MANAGING ANOREXIA. Administration of an adrenergic drug may cause anorexia in the patient. Management of this adverse reaction requires diligence on the part of the nurse. The nurse discusses food preferences and aversions with the patient and makes modifications in the diet when possible. An easily digested diet high in carbohydrate and protein and low in fat is usually well tolerated. Several small meals may be better tolerated than three large meals. The nurse weighs the patient daily or weekly and keeps an accurate dietary record. Foods that cause increased gastric motility, such as gas-forming foods, spicy foods, and caffeinated beverages, are avoided. Good oral care is provided. The dietitian may be consulted if necessary. The nurse provides a pleasant, odor-free, relaxing environment for eating.

MANAGING SLEEP DISTURBANCES. The patient taking an adrenergic drug may experience insomnia and nervousness. This can cause a great deal of stress in the patient. It is important to inform the patient that this is an effect of the drug. It is helpful to identify circumstances that disturb sleep, such as the nurse taking vital signs during the night or turning the overhead light on during the night. The nurse plans care with as few interruptions as possible or makes modifications. For example, instead of turning the overhead light on during the night, a night light may be used. However, monitoring vital signs is an important nursing intervention when administering the adrenergic drugs. A thorough explanation of the reason for close monitoring of the vital signs by the nurse is necessary. In addition, caffeinated beverages are avoided, especially after 5:00 PM. Other sleep aids may be used (eg, warm milk, back rub, progressive relaxation, or bedtime snack). The patient is assured that sleeplessness and nervousness will pass when the drug therapy is discontinued.

### Educating the Patient and Family

Only medical personnel give some adrenergic drugs, such as the vasopressors. The nurse's responsibility for teaching involves explaining the drug to the patient or family. Depending on the situation, the nurse may include facts such as how the drug will be given (eg, the route of administration) and what results are expected. The nurse must use judgment regarding some of the information given to the patient or family regarding administration of an adrenergic drug in life-threatening situations because certain facts, such as the seriousness of the patient's condition, are usually best given by the primary health care provider.

EDUCATING THE PATIENT USING A NASAL DECONGESTANT. When a nasal decongestant (drops or spray) containing an adrenergic drug has been recommended or prescribed, the nurse shows the patient or family member the correct method of instillation. The nurse explains possible adverse effects and the importance of adherence to the dose regimen prescribed by the primary health care provider. Because many nasal decongestants are over-the-counter (OTC) drugs, the nurse advises patients using them that these drugs are contraindicated in those with high blood pressure and that overuse can increase nasal congestion (rebound congestion).

EDUCATING THE PATIENT PRESCRIBED A BRONCHODILATOR. If an adrenergic drug, such as ephedrine or isoproterenol, has been prescribed as a bronchodilator, the nurse explains the drug regimen to the patient (see Chap. 37 for additional information). It is important to stress the importance of reporting adverse reactions to the primary health care provider as soon as possible. If the drug is prescribed in sublingual form, the nurse demonstrates the technique of placing the drug under the tongue. The nurse warns the patient not to use any OTC drug unless use has been approved by the primary health care provider. The nurse encourages patients receiving a bronchodilator to contact their primary health care provider if the drug fails to produce at least partial relief of their symptoms.

EDUCATING THE PATIENT PRESCRIBED MIDODRINE. When midodrine is given to patients with severe orthostatic hypotension, the nurse explains the importance of

taking the drug during daytime hours when the patient is upright. The patient can take doses in 3-hour intervals, if needed to control symptoms. The drug should not be taken within 4 hours of bedtime. In addition, to control supine hypertension, a potentially fatal adverse reaction, the patient should not become fully supine. The nurse explains that it may be necessary to sleep with the head of the bed elevated. If urinary retention is a problem, the patient is instructed to urinate before taking the drug. The nurse stresses the importance of returning for regular medical evaluation. The patient is instructed to report any changes in vision, pounding in the head when lying down, slow heart rate, or difficulty urinating.

## EVALUATION

- The therapeutic effect is achieved.
- Adverse reactions are identified, reported to the primary health care provider, and managed successfully.
- The patient verbalizes an understanding of treatment modalities and the importance of continued follow-up care.

## ● *Critical Thinking Exercises*

1. *Mr. Cole is receiving dopamine for the treatment of severe hypotension. In planning the care for Mr. Cole, determine what would be the most important aspects of nursing management. Explain your answers.*
2. *Plan a teaching program to explain the nervous system to a group of nurses at a staff education meeting.*
3. *Discuss the preadministration assessment for a patient requiring an adrenergic drug for hypotension.*
4. *Describe what information is important to include in an education session for a patient taking an adrenergic drug for nasal congestion.*

## ● *Review Questions*

1. The physician prescribes norepinephrine, a potent vasopressor, to be administered to a patient in shock. The rate of the administration of the IV fluid containing the norepinephrine is
   - **A.** maintained at a set rate of infusion
   - **B.** adjusted accordingly to maintain the patient's blood pressure
   - **C.** given at a rate not to exceed 5 mg/min
   - **D.** discontinued when the blood pressure is 100 mm Hg systolic

2. At what intervals would the nurse monitor the blood pressure of a patient taking norepinephrine?
   - **A.** every 5 to 15 minutes
   - **B.** every 30 minute
   - **C.** every hour
   - **D.** every 4 hours

3. Which of the following are the common adverse reactions the nurse would expect with the administration of the adrenergic drugs?
   - **A.** bradycardia, lethargy, bronchial constriction
   - **B.** increase in appetite, nervousness, drowsiness
   - **C.** nausea, vomiting, hypotension
   - **D.** insomnia, nervousness, anorexia

4. When dobutamine is administered with the β-adrenergic blocking drugs the nurse is aware of an increased risk for _____.
   - **A.** seizures
   - **A.** arrhythmias
   - **C.** hypotension
   - **D.** hypertension

5. Epinephrine is administered cautiously in patients with Parkinson's disease because the drug may _____.
   - **A.** precipitate congestive heart failure
   - **B.** temporarily increase rigidity and tremor
   - **C.** decrease the response to antiparkinsonism drugs
   - **D.** cause confusion

## ● *Medication Dosage Problems*

1. Midodrine 2.5 mg is prescribed. The drug is available in 5-mg tablets. The nurse would administer _____.
2. The physician orders 0.5 mg of 1:1000 epinephrine solution IV. The drug is available in 1:1000 solution 1 mg/mL. The nurse administers _____.