LESSON ASSIGNMENT

LESSON 4
Autonomic and Cardiovascular Drugs

LESSON ASSIGNMENT
Paragraphs 4-1 through 4-35

LESSON OBJECTIVE
Upon completion of this lesson, you should be able to discuss the basic types of autonomic drugs and discuss the actions, uses, untoward effects, administration, cautions, and contraindications for common anticholinergics, adrenergics, vasodilators, antihistamines, drugs used in fluid and electrolyte therapy, hydrocortisone, and mannitol.

SUGGESTION
After studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 4

AUTONOMIC AND CARDIOVASCULAR DRUGS

Section I. THE AUTONOMIC NERVOUS SYSTEM

4-1. INTRODUCTION

The autonomic nervous system is the part of the nervous system that controls the automatic or involuntary functions of the body. Its nerves lead to the heart, blood vessels, glands, stomach, intestines, and other organs that have muscular actions independent of conscious will. The autonomic nervous system is divided into two parts, the sympathetic nervous system and the parasympathetic nervous system. These have nerves leading to the same organs, but the effects of the nerves belonging to each system are different. The basic differences in functions of the two systems are depicted in Table 4-1. Note that the sympathetic nervous system induces a state characteristic of fear or anger and prepares the body for coping with danger by "fight or flight," and the parasympathetic system induces a state characteristic of calmness and security. These states are produced by chemical substances released by the nerve endings of the two systems. The nerve endings of the sympathetic nervous system release norepinephrine, chemically similar to epinephrine (Adrenalin). The nerve endings of the parasympathetic system release acetylcholine (ACh). When these substances are released, the characteristic effects of their respective nervous systems are produced. Norepinephrine produces adrenergic effects, characteristic of fear and stress. ACh produces cholinergic effects, also called muscarinic effects, characteristic of calm, unstrenuous life. In the body, ACh is rapidly hydrolyzed (broken down in a reaction with water) by the action of an enzyme called acetylcholinesterase.

4-2. TYPES OF AUTONOMIC DRUGS

A sympathomimetic (adrenergic) is a drug that mimics the action of norepinephrine, the substance produced by the nerve endings of the sympathetic nervous system. A sympatholytic (antiadrenergic) is a drug that blocks the response of the effector organs to adrenergic stimulation. A parasympathomimetic (cholinergic) is a drug that mimics the action of acetylcholine (ACh), the substance produced by the nerve endings of the parasympathetic nervous system. A parasympatholytic (anticholinergic) is a drug that blocks the parasympathomimetic (muscarinic) effects of ACh.
<table>
<thead>
<tr>
<th>Sympathetic (Adrenergic)</th>
<th>Parasympathetic (Cholinergic)</th>
</tr>
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<tbody>
<tr>
<td>2. Lessens tonus of ciliary muscles, so that the eyes are accommodated to see distant objects.</td>
<td>2. Contracts ciliary muscles, so that the eyes are accommodated to see objects near at hand.</td>
</tr>
<tr>
<td>3. Dilates bronchial tubes.</td>
<td>3. Contracts bronchial tubes.</td>
</tr>
<tr>
<td>4. Quickens and strengthens the action of the heart.</td>
<td>4. Slows the action of the heart.</td>
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<tr>
<td>5. Contracts blood vessels of the skin and viscera so that more blood goes to the muscles Where it is needed for “fight or flight.”</td>
<td>5. Dilates blood vessels.</td>
</tr>
<tr>
<td>6. Inhabits peristalsis. Food “sits like a lump” in the stomach.</td>
<td>6. Increases peristalsis. (Thus, digestion is promoted.)</td>
</tr>
<tr>
<td>7. Decreases secretions of glands (except the sweat glands and the adrenal glands, which secrete more).</td>
<td>7. Increases secretions of glands (except the sweat glands and the adrenal glands). Glands Involved in digestion are stimulated.</td>
</tr>
<tr>
<td>8. Causes contraction of sphincters to prevent emptying of bowels or bladder.</td>
<td>8. Relaxes sphincters so that waste matter can be removed.</td>
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Table 4-1. Functions of the sympathetic and parasympathetic nervous systems.
Section II. ANTICHOLINERGIC (PARASYMPATHOLYTIC) DRUGS

4-3. ATROPINE AS THE STANDARD ANTICHOLINERGIC DRUG

Atropine is the best known of the anticholinergic or parasympatholytic drugs, which inhibit the parasympathetic nervous system. Atropine is an extremely poisonous drug derived from a plant called belladonna. A tincture, an extract, and a leaf fluid extract are still official drugs. Their therapeutic value lies chiefly in their atropine content.

a. Effects. Small doses of atropine cause bradycardia (slow heartbeat), and larger doses cause tachycardia (fast heartbeat). Atropine relaxes all smooth muscles (for example, the muscles lining the intestines) except those of the blood vessels. It decreases the rate of secretion of glands of the respiratory tract, gastric glands, salivary glands, and some sweat glands.

b. Adverse Effects. The side effects of atropine and other parasympatholytics may include dry mouth, blurred vision, fatigue, light-headedness, and dizziness. Older men may suffer urinary retention. These effects may limit the amount of these drugs, which can be given chronically. However, extremely dangerous reactions from normal doses of these drugs are rare with adults, but more frequent with children. Very large doses tend to cause sedation, a disturbed mental state, and even respiratory depression and convulsions. Some clients may acquire a dry, flushed skin, and a high body temperature, which is very dangerous in children.

c. Uses. Atropine and other parasympatholytics have been frequently used in the treatment of peptic ulcer, which they ameliorate by reducing acid secretions in the stomach when it is empty and by decreasing the strength of smooth muscle contractions. They are also used to treat some other GI disturbances, which are not associated with organic disease--diarrhea, belching, spasm of the pylorus (opening through which the stomach empties into the intestine), and "stomach ache" because of overactivity of the GI smooth muscles. These drugs also relieve cystitis (bladder inflammation) by relaxing smooth muscles of the bladder. These drugs are used in the eye to dilate it and to paralyze accommodation (that is, temporarily prevent the eye from focusing). Atropine is sometimes used to counteract some of the effects of cholinergic drugs during or after their use in therapy. One significant use of atropine in the military is to counteract the effects of nerve gas. Atropine is used preoperatively to decrease the amount of saliva and respiratory secretions, especially when an inhalation anesthetic is to be used.

d. Contraindications. A client with glaucoma should never be given a parasympatholytic, except for small doses such as those given just before anesthesia. These drugs should not be given to clients over 35 with a shallow anterior chamber (between the cornea and the lens of the eye). These drugs are not necessary for eye dilation in routine eye examinations. Sympathomimetics are better for this purpose.
e. **Administration.** Atropine sulfate is a very poisonous drug. Therefore, when it is administered to a client, extreme care should be used to ensure that an overdose is not given.

   (1) Belladonna is given orally, often in combination with other drugs as an antispasmodic. The usual dose of the tincture is 0.6-ml, while the usual dose of the tablet is one or two tablets three times a day at mealtime and one or two tablets at bedtime.

   (2) Atropine is given orally, parenterally, or topically (in the eye). The usual adult dose preoperatively is 0.5-mg (1/120-gr) given intramuscularly together with the preoperative analgesic. The usual dose given to treat persons exposed to nerve gas is 2 mg given at 10-minute intervals for three doses. In addition, one percent atropine sulfate ophthalmic ointment is applied in the victim's eyes after first irrigating them with water for 30 seconds.

f. **Storage.** Belladonna tincture should be stored in tightly closed, light-resistant containers away from extreme heat or cold. Atropine for injection should not be allowed to freeze, and atropine sulfate ophthalmic solution is subject to deterioration as indicated on the manufacturer's label.

g. **How Supplied.**

   (1) Belladonna is supplied as a tincture and in tablets with phenobarbital combined.

   (2) Atropine is supplied for injection in automatic plastic injectors and in collapsible tubes with needles attached, each containing 2-mg of atropine. Atropine sulfate injection is supplied in 25-ml vials (2-mg per ml) and in 20-ml vials (0.4-mg per ml). There are 1-mg tablets for the treatment of nerve gas casualties only. Atropine is also supplied as a one-percent ophthalmic ointment and as a one-percent ophthalmic solution.

4-4. **PROPANTHELINE**

a. **Action and Uses.** Propantheline bromide (trade name: Pro-Banthine) is an antispasmodic similar in action to atropine, but having a longer duration of action, and a greater ability to decrease gastric secretion. It is used for the symptomatic treatment of peptic ulcer; it does not cure ulcers.

b. **Administration.** The drug is given orally or by injection. The usual dose is 15 mg with meals, and 15 to 30 mg at bedtime. The effects of a therapeutic dose of this drug last for about 6 hours.

c. **Untoward Effects.** The untoward effects of this drug are the same as those with belladonna and atropine, but not as severe.
d. **Cautions and Contraindications.** This drug is contraindicated for persons with glaucoma.

e. **How Supplied.** The drug is supplied as 15-mg tablets and as sterile propantheline bromide in 30-mg vials, which must be diluted for intramuscular or intravenous injection, according to the manufacturer’s instructions.

4-5. **HOMATROPINE HYDROCHLORIDE OPHTHALMIC OINTMENT**

Homatropine hydrochloride ophthalmic ointment paralyzes visual accommodation for ophthalmological procedures. Recovery from this effect is complete in one day. It must be used with care in persons disposed to glaucoma.

**Section III. ADRENERGIC (SYMPATHOMIMETIC) DRUGS**

4-6. **INTRODUCTION**

The sympathomimetic drugs stimulate the structures innervated by the sympathetic (adrenergic) nerves and produce effects similar to those caused by stimulation of these nerves. The basic compound to which sympathomimetic, or "sympathetic-mimicking," drugs are generally compared is epinephrine. Other drugs in this class have actions similar to epinephrine. For this reason, epinephrine will be discussed first and the other drugs compared to it. (The amphetamines, which also are sympathomimetics, are used primarily as CNS stimulants and are, therefore, discussed in the section on CNS stimulants.)

4-7. **EPINEPHRINE**

The most important actions of epinephrine (Adrenalin) are on the heart and blood vessels.

a. **Actions.** Epinephrine is not effective orally, as it is destroyed in the stomach before it can be absorbed. When injected or inhaled, the actions of epinephrine include:

   (1) Acceleration of the heart and increase in cardiac output. The cardiac rhythm is altered.

   (2) Constriction of blood vessels in some areas and dilation in others. The vessels in the skin and in the mucosa are constricted after local application of the drug, while those of the skeletal muscles are dilated by injection.

   (3) Relaxation of the bronchial musculature and the muscles of the GI tract and urinary bladder.
(4) When applied locally to the eyes, occasionally a mydriatic effect (dilation of the pupils) will occur.

b. Therapeutic Uses. Epinephrine is used to control hemorrhage from minor cuts, but it is not effective when a vein or artery is involved. It relieves nasal congestion by vasoconstriction for a short duration. It is used in conjunction with local anesthetics to prolong their action and to lessen the possibility of hemorrhage. Epinephrine is valuable in treating bronchial asthma, as an injection or by inhalation. It is also used frequently to relieve such allergic disorders as urticaria, serum reactions, and anaphylactic shock, for which epinephrine is the most often used drug. Certain heart failures can be corrected by injecting epinephrine directly into the heart. However, epinephrine is not of much value in the treatment of hemorrhagic, cardiogenic, or traumatic shock or circulatory collapse, and it may be harmful.

c. Administration. For the treatment of anaphylactic shock, epinephrine may be given IM as 1.0 ml of the 1:1000 solution. In general, the solutions for injection may be given SC, IM, or IV. However, the suspension in oil is preferably administered IM, though it may be given subcutaneously.

d. Untoward Effects. Some undesirable effects of this drug include insomnia, nervousness, anxiety, tremors, headache, and rapid heartbeat.

e. Cautions and Contraindications. Extreme care should be used to ensure that a dosage of epinephrine prepared for a client is in the appropriate concentration and amount. Because of its powerful vasopressor action, overdosage is especially dangerous in a client with an open wound, since fresh hemorrhage may result when the blood pressure is markedly elevated. Epinephrine is contraindicated for persons with heart disorders. An epinephrine preparation should be clear and colorless. If the solution is colored or has a sediment, it should not be used. All epinephrine preparations should be kept from freezing, and the package should be checked for the expiration date.

f. How Supplied. Epinephrine is available in strengths of 1:1000 for injection (in 1 ml cartridge-needle units and 1 ml ampules), 1:2600 for injection (in 1 ml ampules), and a 1:500 suspension in oil for intramuscular injection (in 1 ml ampules). It is also available in 1 percent and 2 percent ophthalmic solutions.

4-8. Ephedrine

a. Action and Uses. Ephedrine occurs naturally in various plants. This drug is very similar to epinephrine in its action. The administration of ephedrine results in vasoconstriction and stimulation of the heart that produces an elevation of blood pressure. Although this effect upon the blood pressure is not as great as that produced by the administration of epinephrine, it lasts seven to 10 times as long. The use of ephedrine produces relaxation of bronchial muscles that is less prominent than that obtained with epinephrine, but is sustained for a much longer time. This action of
sustained bronchial relaxation is responsible for the greatest use of ephedrine—to facilitate breathing in chronic asthmatic conditions, and in treatment of hay fever and colds. Ephedrine (or compounds very similar to it in action) is commonly used in many preparations for the treatment of colds. Also, this drug may be given by intramuscular or intravenous injection prior to the administration of spinal anesthesia, because this use of the drug will enable blood pressure to be maintained during the operation. Ephedrine has a stimulating effect upon the central nervous system that is greater than that obtained with epinephrine. Ephedrine also acts to relieve nasal congestion.

b. **Administration.** The usual dose to be given either orally or parenterally is 25 to 50 mg. Two or three drops of a one-percent solution are usually given as nose drops.

c. **Differences Between Epinephrine and Ephedrine.** Although ephedrine and epinephrine are quite similar in action, there are a number of differences that are important clinically.

1. Ephedrine is effective when given orally, whereas epinephrine must be given by injection (except when used as a spray or inhalation for asthmatic attacks.)

2. Ephedrine has a longer duration of action than epinephrine does, but ephedrine also has a slower onset of action. These properties make ephedrine better suited for the treatment of chronic asthma and of colds.

3. Epinephrine has a greater vasoconstricting effect than ephedrine.

4. A tolerance to ephedrine may be acquired but not to epinephrine.

5. Ephedrine has a greater stimulating effect upon the central nervous system than does epinephrine.

6. Ephedrine has a much lower potency than epinephrine.

d. **Untoward Effects.** The main toxic effect of ephedrine is anxiety. A tolerance to the drug may be acquired.

e. **Cautions and Contraindications.** Clients may acquire a tolerance to the drug. If ephedrine is to be used in nose drops, the drug should be dissolved in water and not in oil. Continuous use of an oily preparation in the nose can cause lipid pneumonia (pneumonia due to the aspiration of oil). Liquid preparations of ephedrine should be protected from freezing. Like epinephrine, ephedrine should be used with caution, if at all, in clients with heart disease, high blood pressure, hyperthyroidism, and diabetes mellitus.

f. **How Supplied.** Ephedrine sulfate is supplied as a powder, as a 25-mg capsule, and as an injection which contains 25 or 50-mg of the drug per ml.
4-9. **METARAMINOL BITARTRATE INJECTION**

a. **Action and Uses.** Metaraminol (Aramine) is a vasopressor drug used to raise the blood pressure of clients in some types of hypotensive states. Metaraminol has a longer duration of action than epinephrine: The vasopressor effect of an intramuscular dose of 5 mg of metaraminol lasts for about 1 1/2 hours.

b. **Administration.** This drug can be given by either intramuscular or intravenous injection. It should not be given subcutaneously, as tissue sloughing may result when it is so administered. The usual dose is 1 ml of a one percent preparation, which is 10 mg of the drug. The drug may be included in solution for intravenous infusion, the rate of flow being regulated according to the client's response to the drug.

c. **Untoward Effects.** Toxic reactions to a therapeutic dose of the drug are rare, but hypertension may result, if too much is given. Hypertension is especially dangerous in a client with an open wound, since the elevated blood pressure may lead to fresh hemorrhage.

d. **Cautions and Contraindications.** This drug should not be given by subcutaneous injection, since tissue sloughing may result from such administration. Metaraminol deteriorates after 60 months; therefore, the date on the package should be checked before the drug is given. When this drug is given in a solution by the intravenous route, the client's blood pressure should be monitored frequently (5 to 10 minute intervals) and the rate of flow adjusted to the client's response.

e. **How Supplied.** Metaraminol bitartrate injection is supplied in 10-ml vials, each milliliter containing 10-mg of metaraminol.

4-10. **PHENYLEPHRINE HYDROCHLORIDE**

Phenylephrine (Neo-Synephrine) is similar in structure and action to epinephrine and has a vasopressor action when injected or taken orally. When applied locally to mucous membrane, it acts as a vasoconstrictor, reducing swelling and congestion, and is the most widely used nose drop preparation for decongestion. It is often combined with local anesthetics in a similar manner to epinephrine. Phenylephrine is also used in eye solutions as a conjunctival decongestant, vasoconstrictor, and mydriatic. Its action is superior to that of ephedrine in maintaining blood pressure during spinal anesthesia.

4-11. **MISCELLANEOUS SYMPATHOMIMETICS**

a. **Levarterenol Bitartrate Injection** (norepinephrine; Levophed). Levarterenol is provided in the Field Shock Treatment Surgical Instrument and Supply Set as a 0.2 injection in 4-ml ampules. It produces general vasoconstriction without stimulating the heart. (In the treatment of shock, one ampule may be added to 1000 ml of a dextrose solution and given by intravenous infusion. Rate of flow must be carefully regulated to
obtain and maintain the desired effect. Blood pressure readings must be taken at 5 to 15 minute intervals to avoid overdosage. Someone must stay with the client continuously to see that the drug does not leak into the subcutaneous tissue, because dangerous necrosis of tissue can result from such leakage.) However, the first definitive treatment of shock, after obvious bleeding has been controlled, is the restoration of adequate blood volume. When levarterenol is used to treat shock, despite adequate restoration of blood pressure, failures occur in approximately 50 percent of cases. The rationale of its use is questionable.

b. **Isoproterenol Hydrochloride** (Isuprel Hydrochloride). Isoproterenol is very closely related chemically to epinephrine, but it is a pure vasodilator. It is used in the symptomatic relief of asthma. Unreliable when administered orally, it is usually given by inhalation.

c. **Oxymetazoline Hydrochloride** (Afrin Hydrochloride). Oxymetazoline hydrochloride is included as a 0.05 percent solution in the Battalion Aid Station Medical Equipment Set. It is used as a decongestant for allergic rhinitis (inflammation of the mucous membranes of the nose).

d. **Phenylpropanolamine Hydrochloride** (Propradrine). This drug has actions similar to ephedrine, but with slightly longer action and less CNS stimulation. It is used in nasal congestion and bronchial asthma.

e. **Propylhexedrine** (Benzedrex). This is a decongestant used by inhalation.

f. **Xylometazoline Hydrochloride** (Otrivin Hydrochloride). This is a nasal decongestant.

**Section IV. VASODILATOR DRUGS**

**4-12. INTRODUCTION**

The nitrites and organic nitrates are a group of drugs whose basic action is to relax smooth muscles. They produce vasodilation, which results in a lowering of blood pressure, venous dilatation and pooling, and a decreased cardiac workload. Their chief use is in the relief of attacks of angina pectoris (spasmodic suffocative chest pain), and they may be used to relieve acute attacks of hypertension and asthma. These drugs have a relatively short duration of action, however, and are not suited for the treatment of chronic hypertension. Because better drugs are available, they are not routinely used in the treatment of asthma. Untoward effects of these drugs include flushing of the skin, headache, nausea, vomiting, dizziness, fainting, and a faster heartbeat. A tolerance to these drugs is easily acquired; therefore, a client may need to increase the dosage progressively to obtain the desired response from the drug.
4-13. AMYLNITRITE

a. **Action and Uses.** Amyl nitrite has the action discussed above. In addition to its therapeutic use in the treatment of angina pectoris, it may be used to combat the effects of cyanide gas poisoning.

b. **Administration.** This drug is administered by inhalation. The pearl (ampule covered with a cloth mesh) is crushed in a handkerchief or in paper tissue and placed over the client's nose. The client inhales the fumes two or three times. When he has inhaled about 0.3 ml of the drug (average dose), there is onset of action within 20 seconds, which lasts for 7 to 10 minutes. When administered to a victim of cyanide gas poisoning, two pearls should be crushed and placed inside his gas mask. The original dose of two pearls is repeated three times (eight ampules).

c. **Caution.** Amyl nitrite should not be used in the presence of flame, because it is a very flammable agent.

d. **How Supplied.** The drug is supplied in 0.33-ml pearls, which should be kept refrigerated but protected from freezing. The drug is subject to deterioration after 24 months.

4-14. NITROGLYCERIN TABLETS

a. **Action and Uses.** Nitroglycerin tablets (glyceryl trinitrate tablets) are used chiefly to give relief from the pain associated with angina pectoris attacks. This drug may also be used as an aid in the diagnosis of migraine.

b. **Administration.** The tablets are administered sublingually (placed under the tongue and allowed to dissolve) in a dose of 0.3 to 0.6 mg. The onset of action of the drug commonly takes about 30 seconds, and its effects last for 20 to 30 minutes.

c. **How Supplied.** Nitroglycerin is available as soluble tablets, 0.3 mg, 0.4 mg, and 0.6-mg in strength.

Section V. FLUID AND ELECTROLYTE THERAPY

4-15. FLUID VOLUME REPLACEMENT

a. **Discussion.** The essential need in hypovolemic (oligemic) shock is restoration of the depleted fluid volume. When fluid volume is restored, the improvement in the circulation permits the most effective use of the blood that the client has not lost.

b. **Choice of Replacement Fluid.** The choice of replacement fluid is based on the type of fluid lost (whether whole blood, plasma, or water and electrolytes), the availability of specific fluids, and laboratory facilities. Whole blood is often the most
effective, but other fluids should be given until completion of the necessary laboratory work and acquisition of the correct type of blood. A frequent course in hypovolemic shock is to immediately administer 500-2000 ml of sodium chloride injection (physiologic saline), Ringer's injection, lactated Ringer's injection, or five percent dextrose in saline rapidly intravenously, while making preparations of plasma protein fraction, serum albumin, or whole blood.

c. **General Precautions for Intravenous Solutions.**

(1) Do not overload the client with fluids.

(2) Check expiration date of solution.

(3) Do not administer a solution which is discolored or contains sediment.

(4) Do not administer if leakage from the bag is detected.

(5) Check urine output per hour.

4-16. **NORMAL HUMAN SERUM ALBUMIN**

a. **Action and Uses.** The albumin content in normal human serum albumin is a large-molecule protein extracted from human blood. It is an effective but potentially harmful blood volume substitute in emergencies; it is useful when the client has lung injury, because it acts by drawing fluid into the blood vessels from the surrounding tissues. This preparation is used also in other clinical situations where protein replacement therapy is indicated--such as nephrosis, certain skin diseases, and others. One vial of 25 percent albumin (100 ml) is equivalent to 500 ml of plasma.

b. **Administration.** Albumin is administered by intravenous infusion. The usual dose is 100 ml of 25 percent solution or 500 ml of a five-percent solution.

c. **Untoward Effects.** There are no untoward reactions to the administration of albumin in therapeutic amounts. However, unless this drug is given concurrently with infusions of saline or dextrose solutions, it will worsen the condition of a dehydrated client by drawing additional fluid from his tissues.

d. **Cautions and Contraindications.** This preparation should be refrigerated, however, it is damaged by freezing. The 25 percent solution has a potency period of 120 months when the drug is refrigerated, but its life is only half this long if it is not refrigerated. It should not be used if no vacuum is detected when the intravenous hookup is inserted into the bottle. As noted above, the preparation should be administered simultaneously with solutions of saline and dextrose when used in the treatment of dehydrated clients.
e. **How Supplied.** The 25 percent solution is supplied in vacuum-sealed cans containing 100 ml of the drug in an infusion bottle, with the equipment for sterile intravenous infusion. The 5 percent solution is provided in 500-ml bottles, also with an intravenous injection set.

**4-17. PLASMA PROTEIN FRACTION**

a. **Action and Uses.** Plasma protein fraction, derived from human donor plasma, is a 5 percent solution of plasma proteins, mainly albumin, but excluding certain unstable globulins. Its use and effects are very similar to normal human serum albumin, discussed above. It is used for a plasma substitute in treating shock and as a source of protein for intravenous feeding. Of course, it contains no clotting factors.

b. **Administration.** The usual minimum dose is 250-500 ml by IV infusion, not exceeding 8 ml per minute. Continued administration is dependent on the client's response to therapy.

c. **Cautions.** The period of potency is 60 months when stored at a temperature not exceeding 30°C (86°F).

d. **How Supplied.** Plasma protein fraction is supplied as a 5 percent solution in 250-ml and 500-ml bottles, with an intravenous injection set.

**4-18. DEXTROSE SOLUTIONS**

a. **Actions and Uses.** Dextrose (glucose), often 5 percent in water, is given to correct nutritional and water deficiency when the oral route cannot be used. Five-percent solutions of dextrose have nearly the same osmotic pressure as the body fluids. In addition to their use in the treatment of dehydration, five-percent dextrose solutions in saline (dextrose and sodium chloride injection, dextrose in lactated Ringer's injection, or dextrose in Ringer's injection) may be used in the emergency treatment of hypovolemic shock until preferred fluids are available. A 50-percent dextrose injection acts as a diuretic and is used in the relief of edema.

b. **Administration.** Dextrose solutions are most commonly given by intravenous infusion. Rarely, they may be given orally or rectally. One to three liters of a 10-percent solution (about 400 calories) are usually given for nutritional deficiency. One to two liters of a 5 percent solution in saline is usually used as a plasma expander. Fifty to 100-ml of a 50 percent solution are usually given to produce a diuretic effect.

c. **Untoward Effects.** Too much dextrose solution with sodium chloride can cause edema. Too much dextrose solution without sodium chloride can cause a clumping of the red blood cells.

d. **Cautions and Contraindications.** Dextrose solutions should be kept from freezing. They should not be used if there is sediment in the bottle. Use cautiously in
diabetics. A client receiving dextrose solutions by intravenous infusion should be observed for signs of edema. Puffing of the hands and feet indicates that the client is becoming edematous. In addition, the infusion site should be observed for infiltration of the solution into the tissues, as indicated by swelling of the tissues around the needle. Should infiltration occur, the infusion should be discontinued and restarted at a new site.

e. **How Supplied.**

(1) **Dextrose and sodium chloride (NaCl) injection.** Various preparations are available: 0.5 percent dextrose in 0.45 percent NaCl; five-percent dextrose in 0.2-percent, 0.33 percent, 0.45-percent, or 0.9-percent NaCl; and 10-percent dextrose in 0.9-percent NaCl. Most of the preparations are available in transparent, flexible plastic, single-dose containers. The most frequently used preparations contain five-percent dextrose in 0.9-percent NaCl, available in 250-ml, 500-ml, and 100-ml bags. A solution of 2.5-percent dextrose in 0.45 percent NaCl is supplied in 250-ml bags for pediatric use.

(2) **Dextrose and sodium chloride injection, modified.** This solution contains five-percent dextrose in 0.9-percent NaCl. It is supplied in a 1000-ml transparent, flexible plastic, single-dose container with graduation intervals at each 100-ml. An infusion set and swab-type antiseptic ampule are included in the carton, which converts to an arm board.

(3) **Dextrose in lactated Ringer's injection.** This five-percent dextrose solution is supplied in 500-ml and 1000-ml flexible plastic containers.

(4) **Dextrose in Ringer's injection.** This five-percent dextrose solution is supplied in 500-ml and 1000-ml flexible plastic containers.

(5) **Dextrose injection, modified.** This five-percent dextrose solution is supplied in 1000-ml flexible plastic containers similar to that for dextrose and sodium chloride injection, modified (see (2) above).

(6) **Dextrose injection.** Dextrose injection is available in five percent, 10 percent, and 50 percent strengths in various types and sizes of containers.

**4-19. SODIUM CHLORIDE INJECTION**

a. **Action and Uses.** Sodium chloride injection (normal saline solution; physiological salt solution) is a 0.9-percent solution of sodium chloride, which gives it the same osmotic pressure (makes it isotonic with) as the body fluids. This preparation is of great value in the treatment of dehydration, which is frequently associated with shock. Also, it will replenish body salt (electrolyte) loss. Since it passes out of the circulatory system very quickly, it is only briefly effective as a volume replacement fluid
in hypovolemic shock. Normal saline solution is also used to irrigate wounds, because it is not irritating to tissue.

b. **Administration.** Sodium chloride injection is given parenterally. About 2000 ml, or more, of sodium chloride per day by intravenous infusion is required to keep the client's urine output at a desired amount of 1200 to 1500 ml of urine for each 24-hour period.

c. **Untoward Effects.** The intravenous infusion of sodium chloride can lead to edema, acidosis, and loss of potassium—especially when therapy is continued over a prolonged period.

d. **Cautions and Contraindications.** This preparation should be kept from freezing. It should not be used for intravenous infusion if it is discolored, or it contains sediment, or if no vacuum is detected when the intravenous assembly is attached.

e. **How Supplied.** Sodium chloride injection is supplied in 5-ml-ampules, in an infusion bag containing 250-ml for pediatric parenteral use, and in infusion bags containing 1000 ml for parenteral use. It is also supplied in 150-ml, 250-ml, 500-ml, and 1000-ml transparent, flexible plastic, single-dose containers. Sodium chloride injection, modified, is supplied in 1000-ml flexible plastic containers with graduation intervals at each 100-ml, including an infusion set, swab-type antiseptic ampule, and a carton that converts into an armboard.

4-20. **RINGER'S INJECTION**

a. **Action and Uses.** Ringer's injection is an isotonic solution which supplies the three important cations: sodium, potassium, and calcium. It has a slightly greater therapeutic value as a fluid and electrolyte replenisher than sodium chloride injection. However, large volumes of Ringer's injection, like sodium chloride injection, alter the acid-base balance.

b. **Administration.** The usual dose by intravenous infusion is 1000-ml.

c. **How Supplied.** Ringer's injection is supplied in 500-ml and 1000-ml transparent, flexible plastic, single-dose containers.

4-21. **LACTATED RINGER'S INJECTION**

a. **Action and Uses.** Lactated Ringer's injection is used as a fluid and electrolyte replenisher. Designed to avoid the tendency of sodium chloride injection to cause acidosis, it also supplies the important cations: sodium, potassium, and calcium. Sodium lactate is included because lactate eventually metabolizes to bicarbonate and thus alkalinizes the body fluids. However, bicarbonate itself is not included because it tends to hasten the calcium ions as calcium carbonate in heated solutions.

b. **Administration.** The usual dose by intravenous infusion is 1000-ml.
c. **How Supplied.** Lactated Ringer's injection is supplied in 1000-ml transparent, flexible plastic, single-dose containers.

### 4-22. POTASSIUM CHLORIDE INJECTION

a. **Action and Uses.** Potassium chloride injection is used to treat hypokalemia, a deficiency of potassium in the blood. Hypokalemia may result from prolonged vomiting or diarrhea, treatment with adrenal steroids or diuretics (especially the thiazides), and kidney tubule malfunction.

b. **Administration.** It is important to confirm adequate renal function when administering potassium, since the kidney is the principle route of excretion. Except in an emergency in which serum K is extremely low and cardiac and respiratory muscle activity is seriously impaired, the rate of administration should be 10-20-mEq per hour, or less. A total dose of 1-3 mEq/kg/24 hours may be given in glucose or saline solutions.

c. **Effects of Overdose.** The symptoms of overdose include paresthesias (abnormal sensations), general weakness or paralysis, mental confusion, hypotension, cardiac arrhythmias, and heart block.

d. **How Supplied.** Potassium chloride injection is supplied in 10-ml ampules. Each milliliter contains two milliequivalents of potassium ion.

### 4-23. SODIUM BICARBONATE INJECTION

a. **Action and Uses.** Sodium bicarbonate is specific in the treatment of systemic acidosis, since the salt is composed of the two ions essential to correct this condition. Large quantities of sodium bicarbonate are needed only in unusual and threatening conditions.

b. **Administration.** It is difficult to set a general dosage schedule for sodium bicarbonate in the treatment of metabolic acidosis. In chronic, stable conditions, it is possible to begin with very small doses and find the correct dose empirically. The drug is usually administered in 5 percent dextrose in water in concentrations from 44 to 176-mEq/L.

c. **Precautions.** An overdose may result in systemic alkalosis. Clients with renal failure may demonstrate circulatory failure or tetany during alkali therapy.

d. **How Supplied.** Sodium bicarbonate injection is supplied in 50-ml ampules. Each ampule contains 44.6-milliequivalents of sodium.
Section VI. ANTIHISTAMINES

4-24. INTRODUCTION

In order to understand the role of the histamine-antagonizing agents (antihistamines), you must be familiar with histamine and its effects on the body. Histamine, a basic amine, may be found wherever protein is broken down into its component amino acids in the presence of putrefactive organisms; thus, it is found in the intestines, and in the putrefaction of meats. It occurs as well in all body tissues and is present in the highest concentration in the lungs. Histamine is not normally found in the bloodstream. It is released at the time of their injury.

4-25. HISTAMINE POISONING

When injected into the body, histamine causes swelling and itching. The affected area may be very sensitive to pressure. Headache and congestion of the head occur. Breathing becomes difficult. The body systems are affected as follows:

a. **Circulatory.** After histamine is injected, there is a short initial rise in blood pressure due to direct action on the smooth muscle, followed by a marked fall in pressure because of dilation of the capillaries. The walls of the capillaries lose tone and become distended with blood. The client "bleeds" into his own capillaries, and shock and collapse follow.

b. **Respiratory.** Histamine causes constriction of smooth muscle (with the exception of the blood vessels). The resulting constriction of the bronchioles makes respiration labored and difficult. This smooth muscle action is not antagonized by atropine, because histamine acts directly on the cells of the muscles rather than on their nerve innervation.

c. **Stomach and Intestines; Uterus.** Histamine causes the stomach, intestines, and uterus to contract more powerfully. Spasm may occur.

4-26. ALLERGY AND ANAPHYLAXIS WITH HISTAMINE

Histamine has been demonstrated to have an important role in allergic reactions. Reactions produced by the injection of histamine and those seen with anaphylactic shock and allergic reaction seem identical, that is, contraction of the bronchioles, low blood pressure, increased gastrointestinal motility, increased permeability of the capillaries resulting in edema in the skin and mucous membranes, increase in lacrimal fluid, nasal discharge and fluid in the lungs. There is a nerve-ending reaction in the skin, which produces pain and itching. Since histamine is believed to cause allergic reactions, or at least many of the symptoms, antihistaminic substances are used in the control of hay fever and other allergic manifestations.
4-27. INTRODUCTION TO ANTIHISTAMINES

In 1933, it was discovered that certain compounds had the property of counteracting the effects of histamine. These antihistamine compounds directly antagonize histamine. This action is exerted directly on the peripheral effector cells, which respond to the histamine. We may think of the antihistamine compound as putting a protective coating around the susceptible cells and preventing the histamine from reaching the cells to produce its reaction.

a. **Therapeutic Uses.** The antihistamines are effective in combating conditions caused or aggravated by histamine release in the tissues. They do not cure any condition, but temporarily alleviate symptoms. There is no scientific evidence that antihistamines either prevent or alleviate the common cold. They provide good symptomatic treatment for hay fever, drug reactions, serum reactions, some cases of asthma, and other allergic reactions. Many of the antihistamine compounds are effective antiemetics, that is, agents used to treat or prevent nausea or vomiting; some are particularly effective in the prevention and treatment of motion sickness.

b. **Untoward Effects.** None of the antihistamines is particularly toxic. They have a high therapeutic index, and truly toxic manifestations are infrequent. Minor side effects do occur, such as drowsiness, depression, decreased salivation, and nausea. Drowsiness is the most common side effect. Some have lesser side effects than others do. Clients under antihistamine medication should be warned by their physician not to drive or operate heavy machinery. The sedative effect of antihistamines has been put to use in many sleeping preparations.

4-28. DIPHENHYDRAMINE HYDROCHLORIDE

a. **Uses.** Diphenhydramine (Benadryl) is highly sedative and is often used as a sedative for allergic clients. It is also a useful antiemetic in the treatment of motion sickness and other conditions producing nausea. It may be used to treat parkinsonism.

b. **Administration.** The usual oral dose is 25 to 50-mg, 3 to 4 times daily. The usual intramuscular or intravenous dose is 10 to 50-mg.

c. **Untoward Effects.** Other than sedation, the side effects may include dizziness, ringing in the ears, incoordination, fatigue, double vision, and nervousness. In addition, untoward effects involving the digestive tract may occur. These include loss of appetite, nausea, vomiting, epigastric distress, and constipation or diarrhea. The incidence of these effects can be reduced by giving the drug with food.

d. **Cautions and Contraindications.** This drug should not be administered to people such as truck drivers, aircraft pilots, and others who should stay alert. The solution of the drug for parenteral use should not be allowed to freeze.
e. **How Supplied.** Diphenhydramine hydrochloride is supplied as a powder, as 25-mg and 50-mg capsules, as an elixir, as an ingredient in an expectorant cough syrup (Benylin Expectorant), and as a solution for intravenous or intramuscular injection. The injection is supplied in 10-ml vials (10-mg per ml or 50-mg per ml) and in 1-ml ampules (50 mg each).

4-29. **DIMENHYDRINATE**

Dimenhydrinate (Dramamine) is a mixture of diphenhydramine (discussed above) and 8-chlorotheophylline. The latter contributes very little to the effectiveness of the mixture as an antihistamine or antiemetic. The chief use of dimenhydrinate is as an antinauseant in motion sickness. The usual dose is 50-mg, 4 times daily. It is supplied as 50-mg tablets.

4-30. **MECLIZINE HYDROCHLORIDE**

a. **Action and Uses.** Meclizine (Bonine, Antivert) is used to prevent or treat motion sickness, vertigo, labyrinthitis, and radiation sickness. It is long-acting (9 to 24 hours).

b. **Administration.** The usual adult dose is 25-mg daily.

c. **Contraindications.** Because of the sedative effects of this drug, it should not be used when alertness is required. It is contraindicated in pregnancy.

d. **How Supplied.** Meclizine is supplied in 12.5-mg and 25 mg tablets and as 25-mg chewable tablets.

4-31. **PROMETHAZINE HYDROCHLORIDE**

a. **Uses.** Promethazine (Phenergan) is a very potent phenothiazine-type antihistamine with a long duration of action. In addition to its uses as an antihistamine for allergic condition, it is also useful as an antitussive, an antiemetic, and an obstetrical, surgical, or nighttime sedative.

b. **Administration.** The usual oral or parenteral dose is 25-mg, repeated after 4 hours, if necessary.

c. **How Supplied.** Promethazine hydrochloride is supplied as an injection (25-mg per ml), 25-mg tablets, and 25-mg suppositories. It is also an ingredient in an expectorant cough syrup (Phenergan Expectorant).
4-32. CHLORPHENIRAMINE MALEATE

   a. Uses. Chlorpheniramine maleate is an effective antihistamine with a low incidence of side effects. It is available under many trade names, including Allerest, Chlor-Trimeton, Coricidin, Extendryl, Novahistine, and Teldrin.

   b. Administration. The usual dose is 2-4 mg, 3 or 4 times daily. The usual parenteral dose is 10-20 mg.

   c. How Supplied. Chlorpheniramine maleate is an ingredient of numerous preparations intended for the common cold, sinusitis, and allergic rhinitis. In addition, it is available as the sole ingredient in a syrup (2-mg/5 ml), 4-mg tablets, and 8-mg timed-release tablets.

4-33. TRIPROLIDINE HYDROCHLORIDE

   a. Uses. Triprolidine hydrochloride (Actidil) is an unusually potent antihistamine with a rapid onset of action. The maximum effect occurs in about 3 1/2 hours, and the effect lasts for about 12 hours.

   b. Administration. The usual oral dose is 2.5-mg, 2 or 3 times daily.

   c. How Supplied. Triprolidine hydrochloride is supplied in combination with pseudoephedrine hydrochloride, a sympathomimetic drug included as a decongestant. Actifed is a common trade name for the mixture, available as a syrup (1.25-mg of triprolidine HC1 and 30-mg of pseudoephedrine HC1 per 5 ml) and a tablet (2.5-mg of triprolidine HC1 and 60-mg of pseudoephedrine HC1 per tablet).

Section VII. OTHER AGENTS

4-34. HYDROCORTISONE SODIUM SUCCINATE

   a. Action and Uses. Except for its use in adrenal insufficiency, treatment with hydrocortisone sodium succinate (Solu-Cortef*) (HC) is only palliative. Hydrocortisone sodium succinate is used primarily for its anti-inflammatory effects. It is used in the large single dose described below for some severe life-threatening situations, including severe asthmatic or anaphylactic reactions, acute adrenal cortical insufficiency, and overwhelming infections.

   b. Administration. This drug is given either intramuscularly or intravenously. For the treatment of emergency conditions, the usual dose is 100 mg given over a period of 60 seconds. The symptoms of stress are usually gone about 10 hours from the time of administration of the drug. However, the client may suffer a relapse if the
underlying cause of his condition is severe, or if it is not treated with more definitive agents.

c. **Untoward Effects.** There are virtually no harmful effects to a single dose of this drug, nor even to the use of it for a few days. However, on prolonged use for the treatment of chronic conditions, a number of untoward reactions may occur. The principal ones include fluid and electrolyte disturbances; susceptibility to infections, including tuberculosis; failure of wounds to heal; formation of peptic ulcers, which may bleed or perforate; hyperglycemia (abnormally large amount of blood glucose) and glycosuria (sugar in the urine); a wasting or weakening of muscle tissue; osteoporosis (softening of the bone), which may result in spontaneous fractures; and psychosis. Upon the appearance of any adverse reaction, the drug should be discontinued or the dosage reduced.

d. **Cautions and Contraindications.** For immediate lifesaving therapy, there are no contraindications to the use of the drug. For the long-range treatment of chronic diseases, the drug should not be used on clients with peptic ulcers, nor on those who have a history of psychosis. The drug should be kept from freezing; also, it is subject to deterioration.

e. **Supply.** The equivalent of 100- or 250-mg of hydrocortisone base is supplied in a sterile mixing bottle. The lower section of the bottle contains the drug and the upper section contains sterile water.

4-35. **MANNITOL INJECTION--AN OSMOTIC DIURETIC**

a. **Action.** Diuretics are drugs, which increase the excretion of urine. An osmotic diuretic, such as Mannitol (Osmitrol), easily passes into the renal tubules, however, it is not significantly reabsorbed. It increases the osmotic pressure of the glomerular filtrate, decreases tubular reabsorption, and thus increases the volume of urine.

b. **Indications.** Mannitol injection is indicated for:

(1) Promotion of diuresis, in the prevention or treatment of the oliguric phase of acute renal failure (following hemolytic transfusion reactions) before irreversible renal failure becomes established.

(2) Reduction of intracranial pressure and treatment of cerebral edema.

(3) Reduction of elevated intraocular pressure when the pressure cannot be lowered by other means.

(4) Promoting the urinary excretion of toxic substances.

(5) Use as an irrigating solution in transurethral resection.
(6) Use as a diagnostic aid in measurement of glomerular filtration rate.

c. **Usual Dosage.** The dose of Mannitol varies with the clinical condition being treated and client response.

   (1) **Hemolytic transfusion reactions.** Twenty-five grams are given IV over a five-minute period as soon as a reaction occurs or is suspected. Additional IV fluids should be administered to maintain urine flow at 100-ml/hr. Strict intake and output records should be maintained on the client. If urine output falls below 100-ml/hr, the initial dose of Mannitol may be repeated, but not more than 100-grams per 24 hrs.

   (2) **Urinary excretion of toxic substances.** The passive reabsorption of toxic substances at the proximal tubule can be partially restricted by decreasing the amount of water reabsorbed at that site. An initial loading dose of 25- to 50-grams of Mannitol followed by 10 to 20 grams per hour will produce urine volumes of up to 1000 ml/hr. Fluids and electrolytes must be replaced in the client during this procedure. The effectiveness of Mannitol in increasing renal excretion of glutethimide, meprobamate, barbiturates, and salicylates has been demonstrated. It is potentially useful for all ultrafiltered poisons, which are passively reabsorbed in the proximal tubule.

   (3) **Test for oliguria.** A test dose of 12.5-grams is administered IV over a period of 3 to 5 minutes. If urine output does not increase to 40 to 60-ml/hour over the next three hours, the condition is unresponsive to Mannitol. If a response is obtained, Mannitol should be given by IV infusion to maintain a urine output of 100-ml/hr.

d. **Cautions and Warnings.**

   (1) Mannitol should be administered slowly to avoid sudden increase in plasma volume and dilutional hyponatremia.

   (2) The client's fluid and electrolyte balance should be monitored and restored accordingly.

   (3) Mannitol should not be mixed with blood in a transfusion set, as increased osmotic pressure may cause agglutination.

   (4) The solution should be checked before administration for crystals. Directions for putting the crystals back into solution are on the bottle.

   (5) Mannitol should be used with great caution in clients having congestive heart failure and renal insufficiency. It may cause increased congestion or pulmonary edema.

e. **Adverse Reactions.** Transient headache, nausea, chills, thirst, and pain in the chest may occur during administration.
f. **Supply.** Mannitol injection, 15-percent for use as a diuretic, is supplied in 150-ml bottles. Mannitol injection, 25-percent for use as a diagnostic aid, is supplied in 50-ml quantities.

*Continue with Exercises*

*Return to Table of Contents*
EXERCISES, LESSON 4

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the question or completes the incomplete statement.

After you have completed all of these exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. The nerve endings of the parasympathetic nervous system release a substance responsible for a combination of effects referred to as cholinergic effects. What is the name of this substance?
   a. Acetylcholine.
   b. Epinephrine.
   c. Norepinephrine.
   d. Sympathin.

2. What effects should a parasympathomimetic drug produce?
   a. Adrenergic.
   b. Antiadrenergic.
   c. Cholinergic.
   d. Anticholinergic.

3. What is the basic effect of an anticholinergic drug?
   a. It enhances the action of the sympathetic nervous system.
   b. It blocks the action of the sympathetic nervous system.
   c. It enhances the action of the parasympathetic nervous system.
   d. It blocks the action of the parasympathetic nervous system.
4. What drug may be given to reduce respiratory secretions prior to the administration of ether anesthesia?
   a. Morphine.
   b. Epinephrine.
   c. Atropine.
   d. Hydrocortisone sodium succinate.

5. A drug that is extremely poisonous and the dosage of which should therefore be measured exactly is:
   a. Propantheline.
   b. Atropine.
   c. Paregoric.
   d. Diphenhydramine.

6. What is the basic effect of an adrenergic drug?
   a. It enhances the action of the sympathetic nervous system.
   b. It blocks the action of the sympathetic nervous system.
   c. It enhances the action of the parasympathetic nervous system.
   d. It blocks the action of the parasympathetic nervous system.

7. Which of the following drugs may be used to help control nosebleed?
   a. Epinephrine.
   b. Meperidine.
   c. Hydrocortisone.
   d. Diphenhydramine.
8. It is very dangerous to give a client with an open wound an overdose of a drug that will raise blood pressure because the elevated blood pressure may lead directly to:
   a. Hemorrhage.
   b. Shock.
   c. Hypersensitive reaction.
   d. Depressed respiration.

9. Which of the following sympathomimetics is effective when given orally?
   a. Ephedrine.
   b. Epinephrine.
   c. Isoproterenol.
   d. Levarterenol.

10. Which of the following properties of ephedrine makes it more suitable than epinephrine for use in the treatment of chronic asthma?
    a. Ephedrine's lesser vasoconstricting effect.
    b. Ephedrine's longer duration of action.
    c. Ephedrine's stimulating effect on the central nervous system.
    d. Ephedrine's shrinking effect on swollen nasal mucosa.

11. The subcutaneous injection of Metaraminol may result in:
    a. Sloughing of tissues.
    b. Depression of central nervous system.
    c. Overdosage effects.
    d. Rigidity of muscle tissue.
12. When Metaraminol is being administered intravenously, the client's blood pressure should be taken at which of the following time intervals.

   a. 1-4 minutes.
   b. 5-10 minutes.
   c. 15-20 minutes.
   d. 30-45 minutes.

13. The most widely used decongestant nose drops contain:

   a. Epinephrine.
   b. Ephedrine.
   c. Levarterenol.
   d. Phenylephrine.

14. A drug that acts to lower cardiac workload is:

   a. Ephedrine.
   b. Metaraminol.
   c. Hydrocortisone.
   d. Amyl nitrite.

15. Which of the following drugs is used to treat cyanide gas poisoning?

   a. Nitroglycerin.
   b. Amylnitrite.
   c. Chloramphenicol.
   d. Diphenhydramine hydrochloride.
16. Which of the following drugs is administered by inhalation?
   a. Promethazine.
   b. Diphenhydramine.
   c. Amyl nitrite.
   d. Nitroglycerin.

17. A drug that may be used to help diagnose migraine is:
   a. Caffeine.
   b. Dextroamphetamine.
   c. Hydrocortisone sodium succinate.
   d. Nitroglycerin tablets.

18. The soluble tablets of which of the following drugs are administered sublingually?
   a. Morphine.
   b. Atropine.
   c. Codeine.
   d. Nitroglycerin.

19. You attach an intravenous injection set to a bottle of 5 percent dextrose, and you do not detect a vacuum. What should you do?
   a. Select another injection set.
   b. Select another supply bottle.
   c. Milk the tubing.
   d. Continue with the preparation of the fluid.
20. When normal human serum albumin is administered to a dehydrated client, which of the following solutions should be given concurrently.
   a. Plasma; blood.
   b. Sodium chloride injection; a dextrose solution.
   c. Lactated Ringer's injection; plasma protein fraction.
   d. Sodium bicarbonate injection; potassium chloride injection.

21. Which of the following types of substances are used to reduce the intensity of allergic reactions?
   a. Antiemetics.
   b. Antihistamines.
   c. Parasympatholytics.
   d. Parasympathomimetics.

22. In addition to their use in the treatment of allergies, many antihistamines are also used for their:
   a. Analgesic and antipyretic effects.
   b. Anesthetic and antidiarrheal effects.
   c. Sedative and antiemetic effects.
   d. Stimulant and decongestant effects.

23. A drug that is useful both in the prevention of motion sickness and in the treatment of allergies is:
   a. Ephedrine.
   b. Diphenhydramine.
   c. Atropine.
   d. Epinephrine.
24. Which of the following may be used to prevent renal failure after a hemolytic transfusion reaction?
   a. Atropine.
   b. Epinephrine.
   c. Mannitol injection.
   d. Hydrocortisone sodium succinate.

25. A drug useful as an adjunct in the treatment of symptoms associated with various conditions such as anaphylactic shock is:
   a. Atropine.
   b. Ephedrine.
   c. Mannitol injection.
   d. Hydrocortisone sodium succinate.

*Check Your Answers on Next Page*
SOLUTIONS TO EXERCISES, LESSON 4

1. a (para 4-1)
2. c (paras 4-1, 4-2)
3. d (para 4-3)
4. c (para 4-3c)
5. b (para 4-3e)
6. a (para 4-6)
7. a (paras 4-7a(2), b)
8. a (paras 4-7e; 4-9c)
9. a (para 4-8c(1))
10. b (para 4-8c(2))
11. a (para 4-9b, d)
12. b (para 4-9d)
13. d (para 4-10)
14. d (para 4-12)
15. b (para 4-13a)
16. c (para 4-13b)
17. d (para 4-14a)
18. d (para 4-14b)
19. b (para 4-15c(4))
20. b (paras 4-16c, d; 4-18a; 4-19a)
21. b  (para 4-27a)
22. c  (para 4-27a, b)
23. b  (para 4-28a)
24. c  (paras 4-35b(1), c(1))
25. d  (para 4-34a)