LESSON ASSIGNMENT

LESSON 3
Intravenous Preparations and Methods for Administration.

LESSON ASSIGNMENT
Paragraphs 3-1 through 3-29.

LESSON OBJECTIVES
After completing this lesson, you should be able to:

3-1. Identify the two major types of intravenous solutions and examples/uses of each.

3-2. Identify the requirements and precautions when using intravenous therapy.

3-3. Identify the rules/requirements for veni-puncture site selection.

3-4. Identify the principles that guide the use of intravenous therapy.

3-5. Identify the complications; their signs and symptoms; and the precautionary measures for intravenous therapy.

3-6. Given the required information, calculate the drip rate for an intravenous infusion.

3-7. Identify the type of products used for transfusion, examples of each type of product and their uses.

3-8. Identify the sites used for transfusion venipuncture and the usual transfusion rate.

3-9. Identify the possible adverse reactions to transfusions and their signs and symptoms.

3-10. Identify the general principles governing transfusions.

3-11. Identify examples of the common types of blood tests, their indications and their normal values.
3-12. Identify the steps for the venipuncture procedure and for discontinuing an intravenous infusion.

3-13. Identify the kinds of intravenous systems in use and the parts of the intravenous apparatus.

3-14. Identify special considerations for transfusions.

3-15. Identify the reasons for using a venous cutdown procedure.

3-16. Identify the equipment and supplies needed for the venous cutdown and the sites usually selected.

3-17. Identify the steps of procedure for the venous cutdown.

**SUGGESTION**

After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 3
INTRAVENOUS PREPARATIONS AND METHODS FOR ADMINISTRATION

Section I. INFUSIONS

3-1. INTRODUCTION

Ideally, a person gets the fluids and electrolytes needed to live by the oral route. This route has certain built-in safeguards against bacterial invasion. When the intravenous route of administration must be used, the material being given is injected directly into the circulatory system through the veins. Although, this route is certainly effective in terms of getting the fluid into the patient, the intravenous route is not completely safe. Complications (that is, infection) can happen. In the case of infection, the fluid being administered, the intravenous administration set (the equipment between the bottle or the bag and the patient), and the techniques used to start the fluid administration are possibilities for bacterial contamination. The intravenous administration of fluids is to be taken seriously.

3-2. INTRAVENOUS PREPARATIONS

You may have seen intravenous solutions being administered to a patient. The bottle or bag connected to the patient by a plastic tube means life to many patients.

a. Intravenous Solutions. Intravenous solutions are products that meet certain rigid requirements and are supplied ready for use by manufacturers. Examples of such intravenous solutions are five percent dextrose, 0.9 percent sodium chloride, and lactated Ringer's. These solutions are ready for use as soon as they arrive from the manufacturer. You will see the five percent dextrose and the 0.9 percent sodium chloride used as "to keep open" (TKO) solutions. They serve as a ready and rapid way by which drugs could be given to the patient should the patient go into shock. These solutions serve as a "base" for the admixtures.

b. Intravenous Admixtures. Intravenous admixtures are intravenous solutions to which have been added one or more drugs. For example, it is common for a patient to be administered a liter of five percent dextrose which has 20 mEq of potassium chloride added to it. Thus, the patient received fluid, nutrients (dextrose), and electrolytes (potassium and chloride). Typically, patients receive much more complicated intravenous admixtures. These intravenous admixtures are usually prepared in the Pharmacy Sterile Products Section by specially trained personnel who use aseptic techniques. At times, it may be necessary for the physician or the person administering the infusion to add one or more drugs after the solution is already in place. This is done only on the physicians order.
3-3. CATEGORIES OF INTRAVENOUS FLUIDS AND THEIR USES

Many patients on the battlefield or in hospitals receive intravenous fluid therapy. They receive intravenous fluid therapy for many different reasons. All solutions received aren’t alike. Many patients have intravenous solutions tailored to meet their specific fluid, nutritional, and electrolyte needs, especially if they require long term intravenous therapy.

3-4. HYDRATING SOLUTIONS

a. Use. Hydrating solutions are used to provide the patient with required fluid that is, water). The volume of preparation administered depends on the fluid needs of the patient.

b. Examples. Below are some examples of preparations commonly used as hydrating solutions:

(1) Five Percent Dextrose Solution. Five percent dextrose solution (D5W) consists of dextrose and water. One liter of the five percent dextrose contains approximately 170 calories. This solution contains no appreciable electrolytes. Therefore, electrolytes are sometimes added to the five percent dextrose solution (for example: Fifteen mEq KCL in one liter of D5W). The five percent dextrose solution is used to provide fluid replacement and energy.

NOTE: Dextrose solution is available in several concentrations.

(2) Nine-tenths Percent Sodium Chloride Solution (Normal Saline). This product is a solution of sodium and water. Each 100 milliliters of solution contains 0.9 gram of sodium chloride. Nine-tenths percent sodium chloride solution contains 154 milliequivalents of sodium and 154 milliequivalents of chloride in each 1,000 milliliters of solution. This product is used to provide fluid replacement and to replace moderate losses of the sodium ion (Na⁺).

NOTE: Sodium chloride solutions are also available in other concentrations. For example, 0.45 percent sodium chloride solution is commonly seen.

(3) Five percent Dextrose Solution in 0.9 percent sodium chloride solution. This product has in each 100 milliliters, five grams of dextrose and 0.9 grams of sodium chloride. Not only does this product provide a source of fluid, it also serves as a source of both energy (170 calorie/liter) and sodium. This product is used in fluid replacement, in the replacement of moderate losses of sodium, and as a source of energy.

NOTE: Various combinations of dextrose and sodium chloride are available.
3-5. ELECTROLYTE REPLACEMENT SOLUTIONS

a. Use. Electrolyte replacement solutions provide both electrolytes (like sodium, potassium, and so forth,) and fluid to the patient. Special electrolyte replacement solutions can be prepared in order to meet the needs of particular patients.

b. Examples of Electrolyte Replacement Solutions. Below are two of the solutions commonly used to replace electrolytes.

1. Lactated Ringer’s Solution (LR, Ringer’s Lactate, RL, Hartmann’s Solution). This product is a solution of electrolytes in water. This product contains sodium, potassium, calcium, chloride, and lactate ions. The lactate ion in the product has an alkalizing effect. The lactate ion is metabolized in the liver to glycogen and ends up as carbon dioxide and water. Lactated Ringer’s solution is used as a fluid replacement and as an electrolyte replacement.

2. Lactated Ringer’s Solution with Five Percent Dextrose. This product is a combination of lactated Ringer’s solution and five percent dextrose (D5RL) solution. The dextrose supplies 170 calories per 1,000 milliliters of solution. Lactated Ringer’s solution and five percent dextrose is used as a fluid replacement, electrolyte replacement, and as a source of energy.

NOTE: Other combination products are available.

3-6. NUTRIENT SOLUTIONS (HYPERALIMENTATION PRODUCTS)

These products provide total parenteral nutrition for those patients who cannot, should not, or will not ingest the nutrients they need to live. It should be noted that a hyperalimentation solution can supply all the patient’s nutritional needs by administration through the circulatory system. However, these solutions are quite expensive and, because of their nutrient content, are highly susceptible to bacterial growth. Most of the solutions contain high concentrations of carbohydrates (for example, dextrose). Because of this high concentration, the solutions must be administered through a large-bore vein. Just placing the needle or catheter into such a large-bore vein is a surgical procedure in itself. The hyperalimentation solution is prepared in the Pharmacy Sterile Products Section by a specially trained person. You must be very careful to prevent bacterial contamination. The preparation of the product itself is quite a job because the preparer must add ingredients in a certain sequence. Many of the components of a hyperalimentation solution are incompatible in certain concentrations. The components of most hyperalimentation solutions are water, dextrose, amino acids, electrolytes, and vitamins. One product, IntralipidR, is an oil in water emulsion. IntralipidR is one hyperalimentation product that can be administered through a small-bore vein such as those found in the arm.
3-7. REQUIREMENTS FOR INTRAVENOUS SOLUTIONS/INTRAVENOUS ADMIXTURES

Any solution administered through a patient's veins must be:

a. **Sterile.** Sterile means that no living microorganisms are present in the solution.

b. **Pyrogen-Free.** Pyrogens are substances that produce fever when injected into the circulatory system.

c. **Free from Visible Particulate Matter.** Visible particles in an intravenous preparation mean that the product should be discarded. These particles could have been present in the solution when it arrived in the pharmacy or they may have been accidentally added to the solution when other substances were added. Regardless of origin, these visible particles, if intravenously administered, could cause a blockage in the patient's circulatory system. Filters with very small pores are available which can remove these visible particles as the product is being administered. Remember, the origin of the particles is unknown—it is possible that some particles could be undissolved drug. Removing the drug particles would be good, but if the filtered particles are undissolved drug, by removing them you may be lowering the amount of drug in the solution.

3-8. PRECAUTIONS FOR USING FLUID THERAPY

You will likely be in a position to administer or supervise administration of fluid therapy. Some precautions will be beyond your control, but most will be your responsibility. Carefully watch for the pitfalls shown below, to make sure that the intravenous infusion does the patient more good than harm.

a. **Contamination.** A solution intravenously administered to a patient must be free from living microorganisms. You have a responsibility for using the aseptic technique. When there is doubt about the sterility of the admixture (or intravenous solution), the product should be discarded. Microorganisms are present in the environment of the hospital room. They are on the hands of the person who will start (that is, begin the administration) the intravenous product. Therefore, this person is responsible for using care and aseptic technique to make the venipuncture.

b. **Irritating Drugs.** The veins are very sensitive. Therefore, any intravenous product which has an extreme pH or which is very concentrated can irritate the veins. In some cases, the physician can decide to place the drug in another intravenous solution resulting in a pH that will not irritate the veins as much. In other cases, the site can be changed frequently to allow the part of the vein just used to recover.

c. **Particulate Matter.** Hold a bottle or bag of intravenous solution up in front of a light. See how it is sparkling clear. Actually, small particles called particulate matter
are present in the solution. Standards allow extremely small particles to be present in the solution in certain concentrations. Intravenous solutions or admixtures should never be administered to a patient when the products contain visible particulate matter. A product that is cloudy might actually be cloudy because of suspended particulate matter. Even though filters are available which can filter most particulate matter from intravenous products, do not use a cloudy solution.

3-9. SITE FOR VENIPUNCTURE

a. **Selection.** Site selection for venipuncture depends on:

   (1) **Accessibility of the vein.** A vein should be relatively easy to feel and to stabilize for venipuncture. If this task is too difficult, select another vein.

   (2) **General condition of the vein.** If the vein is in good condition, it will easily take the venipuncture. If the vein is poor, it may collapse upon puncture.

   (3) **Type of fluid to be infused.** If the fluid used is especially irritating, a different site will be suitable from the sites, which can be used for non-irritating fluids.

   (4) **Period the intravenous line is expected to be in place.** Long-term intravenous therapy will often require a different site from the ones that can be used if a single bottle or bag of fluid will be used.

b. **Preferred Sites.** The following sites are generally used and preferred for use by most physicians.

   (1) Distal to the antecubital area (that is, cephalic, basilic, antebrachial veins in the lower arms).

   (2) Veins on the back of the hand.

   (3) Veins in the lower extremities when necessary although danger of thrombophlebitis is considerably greater.

**CAUTION:** Select the largest vein, if possible, when injecting intravenous drugs that may produce sloughing/necrosis injury to the tissues.

   (4) The leg and foot veins may be used on children because these vessels are not sclerosed.

   (5) Scalp veins are used in infants.
3-10. PRINCIPLES OF INTRAVENOUS THERAPY

a. Check all bottles or bags of infusion solution for these specific requirements and discard any that show:

(1) A broken vacuum seal.

(2) Cloudiness.

(3) Precipitation (particles on the bottom of the bag or bottle).

(4) Foreign contaminants.

b. Always, use sterile equipment and wash your hands thoroughly.

c. Disinfect the patient's skin at and around the injection site. Apply antiseptic solution using friction at and around the venipuncture site.

d. For long term therapy patients.

(1) Change the injection site every 48 to 72 hours (to lessen the possibility of infection and/or irritation to the vein), or in accordance with (IAW) local SOP IAW with local standing operating procedures (SOP).

(2) Replace the tubing and solution bottle (or bag) every 24 hours (to avoid infusing a contaminated solution) or IAW local SOP.

(3) Take precautions if vein irritation or thrombophlebitis is possible.

(a) Plastic catheters are more likely to cause irritation than stainless steel needles.

(b) Use the smallest gauge needle or catheter possible.

(c) Use the shortest infusion time possible. Irritation is much more likely after 48 hours of intravenous therapy.

(d) Veins of the lower extremities (in adults) are more likely to develop phlebitis (and quicker) than those of the upper extremities.

(e) Do not irrigate a stopped infusion. You may dislodge an obstructive clot and endanger the patient's life.

(f) You are less likely to irritate the large veins of the central venous system than the smaller peripheral veins.

(g) Strict attention to aseptic techniques is required at all times to prevent sepsis.
3-11. COMPLICATIONS

The complications of intravenous therapy may be mild or life threatening, but they are always uncomfortable for the patient. Many can be prevented with proper care.

a. **Infiltration.** Infiltration (the most frequent) is caused by dislodgement of the needle or catheter, or by puncture of the vein. This allows the fluid to collect in the surrounding tissue. Signs or symptoms include, slowing or stopping of the intravenous flow and reduced skin temperature in the venipuncture area. This is not usually serious but can be very uncomfortable for the patient. You can restart the intravenous at another site. The danger of this happening can be reduced by securely taping the intravenous line and providing arm boards for stability.

b. **Speed Shock or Circulatory Overload.** The "average" person has a blood volume of about five to six quarts. Blood is approximately ninety-one percent fluid. The body has intricate mechanisms for making up for changes in blood volume. For example, when you donate blood, some fluid from the inside of the cells and fluid surrounding the cells enters the circulating blood volume. There is a reverse flow when the blood volume is normal and intravenous fluids are administered. Unfortunately, when too much fluid and/or too much medication is administered too rapidly, circulatory overload can result. Signs and symptoms include patient complaints of pounding headache and chills, a flushed look, irregular pulse, and dyspnea.

c. **Sepsis and Pyrogenic Reactions.** Sepsis and pyrogenic reactions are usually caused by the introduction of pyrogenic organisms or their toxins into the bloodstream. In addition to these organisms, febrile reactions can be caused by various chemicals and certain types of particles. If an infection results, the reaction can be localized or systemic. A systemic reaction can occur about thirty minutes after starting the intravenous infusion. Long-term therapy patients can develop sepsis from the growth of microorganisms on the skin after a two to three day period. Signs and symptoms include an unexpected rise in temperature preceded by chills, nausea, vomiting, backache, and malaise. To reduce the possibility of developing sepsis, use aseptic techniques when starting the infusion and change the infusion site, bottle, and tubing at least every two to three days on long term intravenous therapy patients.

d. **Phlebitis.** Phlebitis is an irritation or injury to the vein. It can be caused by mechanical, chemical, or bacterial irritation. Signs and symptoms include redness, pain, and swelling at the infusion site and patient complaints of fatigue together with fever and a rapid pulse. If signs appear, change the needle to another site and apply warm moist compresses to relieve discomfort and aid healing. Do not rub or massage the affected area. You could cause thrombus or emboli and add to the vein damage. A thrombus is a clot that is formed in the blood vessels. A thrombus is usually a further complication of phlebitis. A clot formed in the vessels can produce damage to tissue below the stoppage.
e. **Air Embolism.** An air embolism is a very serious intravenous therapy complication. It can occur when a sizeable amount of air gets into the circulatory system through the intravenous administration set. It can block a vessel so that tissues are unable to get oxygen. Nutrients and waste products cannot be removed. The air bubble can cut off cardiac, cerebral, or pulmonary circulation. Symptoms include a fall in blood pressure, tachycardia, or rapid pulse and loss of consciousness. If a patient has these symptoms, take his vital signs, place patient on his left lateral side, administer oxygen, and get immediate medical help. Air embolism can be prevented by removing all air (bleeding) from intravenous lines, using venipuncture sites below heart level, and never allowing an intravenous line to run dry before disconnecting or adding another bottle. The larger the embolus, the greater the danger. Death could result.

f. **Solution's Incompatibility.** The signs of incompatibility will differ according to the solution or drug being administered. The effects can vary from neutralizing the effects of a drug to causing circulatory collapse. Some solutions, such as over 10 percent dextrose or potassium chloride, are very irritating in concentrated doses. Sterile water, saline, or special dilutants are required for certain drugs and substitutions should not be made. Incompatible drugs frequently form a precipitate and cause fever, nausea, vomiting, and intense itching.

3-12. **CALCULATING THE INTRAVENOUS DRIP RATE**

In order to infuse a solution ordered by the physician, it is necessary to calculate the infusion rate.

a. The physician who ordered the infusion for the patient will give you the following information:

   1. The type or kind of fluid to be infused.
   2. The amount of fluid to use.
   3. The time period over which the total amount of fluid is to be infused.

b. From the infusion set, you will learn how many drops per ml the set is capable of providing. You must determine how many drops per minute are required in order to set this delivery rate on the infusion set. The formula for determining the drip rate is:

   \[
   \text{Flow rate in drops per minute} = \frac{\text{Volume (in ml) to be infused} \times \text{Drops per ml delivered by the set you are using}}{\text{Infusion time in minutes}}
   \]
3-13. **EXPLANATION OF DRIP RATE FORMULA**

The above formula can be used by following these steps:

a. Multiply the number of ml to be infused (ordered by the physician) by the drops per ml delivered by the set you are using (shown on the infusion set).

b. Multiply the hours of infusion time (ordered by the physician) by 60 minutes.

c. Divide the answer in step number one by the answer in step number two. This answer will be the flow rate.

3-14. **EXAMPLE OF A DRIP RATE CALCULATION**

Let us use an example to illustrate this process. The physician has ordered you to infuse 2000 ml of normal saline. The fluid is to be infused over eight hours. Your infusion set delivers 15 drops per milliliter. How many drops per minute should be administered?

a. Multiply 2000 ml by 15 drops per ml. Answer: 30,000 drops.

b. Multiply 8 hours by 60 minutes. Answer: 480 minutes.

c. Divide 30,000 by 480. Answer: 62 drops per minute.

**Section II. TRANSFUSIONS**

3-15. **INTRODUCTION**

Transfusions of blood or blood products are normally initiated at the direction of the physician during surgery. These transfusions differ from the infusion of other fluids in many ways. The products used are generally prepared in a laboratory. Many products need to be matched to the patient by using laboratory analysis. The rate of transfusion is often slower, and a greater variety of complications is possible. The venipuncture site may be different. Even the equipment differs from other administration sets. Most blood products have special refrigeration requirements to prevent spoilage. The most common reasons for transfusions are replacement of red blood cells for oxygen-carrying capacity or restoration of blood volume. Transfusion should not be initiated too hastily. Most patients in good general health can sustain a loss of about 1,000 milliliters and need replacement by colloid or crystalloid solutions infusion alone. Transfusion should be used as a last resort. It may lower the production of erythrocytes by the patient's own body. The normal red cell has a life span of about 80 to 120 days. Each unit of blood contains red blood cells of all ages between 1 and 120 days. As a unit of blood is stored, the red blood cells continue to age. A unit of blood is stored for no more than 35 days. These aged blood cells are removed from the patient's circulation by his own body within 24 hours after transfusion of the unit of
blood. About 70-79 percent of the red blood cells survive 24 hours after transfusion and begin to age normally. Many surgeons believe that surgical blood loss can usually be replaced with packed red blood cells and saline.

### 3-16. PRODUCTS FOR TRANSFUSION

Sodium chloride solution (normal saline) is the only solution suitable for use in the transfusion of blood products containing red blood cells, platelets, or leukocytes. Any other solution causes adverse effects on the body and/or blood product. There are three general categories of products used for transfusion-products containing red blood cells, plasma products, and plasma expanders.

**a. Red Blood Cell Products.** Red blood cell products generally require type and cross-match laboratory procedures. Examples of these are:

1. **Whole blood (human).** Whole blood is anticoagulated blood from which none of the components have been removed. Acute significant hemorrhage is the only indication for whole blood in medical patients. Traditionally, whole blood has been used to replace blood loss at surgery. This use is gradually changing to the use of packed red blood cells and a balanced saline solution.

2. **Packed red blood cells.** Packed red blood cells have 75 percent of the plasma removed in the laboratory. This preparation is frequently used where the patient needs the oxygen-carrying capacity of the erythrocytes, but would not benefit from the extra fluid or the small amount of protein in the plasma. In many chronic diseases, a further expansion of the plasma volume can cause heart failure. The packed red blood cells also tend to cause less plasma transfusion reactions from donor antibodies. It is safer to use type O Negative packed red blood cells than whole blood when there is no time for cross-match and type O Negative must be used instead.

**b. Plasma.** Plasma (or other blood fraction) products are made either from whole blood or from some other process that leaves part of the blood behind. Some examples of these are:

1. **Whole plasma.** Whole plasma may be a by-product from the preparation of packed red blood cells, made from blood a few days before the expiration date on the blood unit or drawn by plasmapheresis. Plasma is used as fluid replacement caused by hemorrhage, burns, or in other situations where blood volume must be increased without replacement of blood proteins.

2. **Cryoprecipitate.** To make cryoprecipitate, fresh frozen plasma (FFP) is first thawed at 4°C until all ice is melted. Then the cold insoluble fraction of plasma protein is recovered by centrifugation. The product is used for patients with hemophilia. Cryoprecipitate can be stored for two years at -20°C (20 degrees below 0 Celsius).
(3) **Platelet rich plasma.** Platelet rich plasma is used in the treatment of some forms of malignancy. This product may be effective in controlling serious active bleeding, especially in surgery. Because of the short survival rate of platelets, the product has limited use. A-B-O group type match is required. No cross-match of other factors is required prior to platelet transfusion unless the platelet product contains many red blood cells. This does not apply to the platelet rich plasma since the plasma itself may carry antibodies.

c. **Plasma Expanders.** Plasma expanders are used to treat or prevent acute and severe fluid loss due to trauma or surgery. These products are usually used instead of whole blood in emergency-situations in which whole blood is not available. Below are two examples of plasma expanders.

(1) **Normal human serum albumin.** Normal serum albumin is a part of whole blood. It is clear, moderately viscous, brownish fluid contains 25 grams of serum albumin in 100 milliliters of product. Because each gram of albumin holds approximately 18 milliliters of water, it is used as a blood volume expander in the treatment of hemorrhage or shock. In this use, the albumin draws fluid into the circulatory system from the surrounding tissues. This product has also been used as a protein replacement in cases where the level of protein in the serum is very low (for example, in nephrosis). Normal human serum albumin should not be given to dehydrated patients since it draws fluid from the body tissues. If nine-tenths percent, the product may be administered to dehydrated patients, if it is necessary. Sodium chloride solution or five percent dextrose solution is administered at the same time. Fortunately, this product is very stable. Therefore, it is not necessary to keep it refrigerated in its liquid state.

(2) **Plasma protein fraction (plasmanate).** Plasma protein fraction is a sterile solution of stabilized human plasma proteins in nine tenths. Sodium chloride solution. Each 100 milliliters of this product contains approximately five grams of protein. This product is nearly colorless (slightly brown). Plasma protein fraction is used in the treatment of nonhemorrhagic shock (that is, shock not associated with loss of whole blood). Side effects associated with this product are uncommon, but they include increased salivation, nausea, and vomiting.

**3-17. SITE FOR VENIPUNCTURE WHEN A BLOOD PRODUCT IS USED**

Blood products should be administered intravenously although other routes (intraperitoneal, intra-arterial, intrabone marrow) are possible. A vein should be selected which will be large enough to accommodate the infusion needle but is comfortable for the patient. Veins in the antecubital fossa are probably more accessible and most widely used; however, infusion in these veins limits the patient's ability to flex the elbow during transfusion. Veins in the forearm and hand are equally suitable for infusion, although venipuncture in these areas is often more painful to the patient.
3-18. RATE OF TRANSFUSION

a. The rate of transfusion of blood products depends upon the clinical condition of the patient and the product being transfused. In most administration sets, 15 drops equal one milliliter.

b. Most patients who are not in congestive heart failure or in danger of fluid overload tolerate the transfusion of one unit of red blood cells in a 1 1/2 to 2 hour period. One unit of whole blood equals about 500 milliliters (about 450 milliliters of blood plus 60 milliliters of anticoagulant). The transfusion should be completed in less than four hours because of the dangers of bacterial growth and red blood cell hemolysis at room temperature. During the first 15 minutes, the rate of transfusion of red blood cells should be very slow, about 100 milliliters per hour. This will keep the volume of red blood cells low in case the patient has an immediate adverse reaction. Watch the patient attentively during the first five minutes and then check after fifteen minutes. At that point, the rate may be increased if the physician orders. After the transfusion, record any adverse reaction and discontinue the intravenous infusion.

3-19. ADVERSE BLOOD PRODUCT REACTIONS

Most adverse transfusion reactions are caused by leukocytes, platelets, and plasma proteins (since red blood cell antibodies have already been checked). All the care in cross-matching blood in the laboratory can be negated by administering the blood to the wrong patient. **Always double-check.**

a. **Immediate Effects.** An adverse effect can be either immediate or delayed. If the effect is immediate and the transfusion reaction involves more than just a reddening of the skin, the transfusion should be stopped immediately, but the intravenous line should be kept open.

   (1) **Congestive heart failure.** Congestive heart failure that is caused by circulatory overload shows up as coughing, cyanosis, and difficulty in breathing. This is probably the most preventable adverse reaction to transfusion. If a patient is susceptible to circulatory overload, concentrated red blood cells should be transfused at no faster than one milliliter per kilogram of body weight per hour.

   (2) **Febrile reactions.** Febrile reactions (fever), often preceded by chills, are the most common adverse transfusion reactions. These reactions are usually mild and result mainly in patient anxiety and discomfort. Rarely, there is some infiltration in the lungs, reduction in the body’s white cells, shock, or death. There are variations in blood products or medications that may lessen febrile complications.

   (3) **Allergic reactions.** Allergic reactions are usually relatively mild. Most are local skin redness, hives, and itching. These are treated with antihistamines. Flushing, nausea and vomiting, diarrhea, changes in blood pressure and anaphylaxis are severe reactions that sometimes require a specially prepared blood product. Some severe reactions can be treated by antihistamines. Others require epinephrine.
Hemolytic reactions. These are often difficult to detect. Initial hemolytic reactions can be flushing, a feeling of apprehension, chest or back pain, chills, fever and nausea, or vomiting. During anesthesia, diffuse bleeding may be the only evidence. Severe reactions include excessive hemoglobin in the blood plasma, hemoglobin in the urine, abnormally low blood pressure, coagulation in the blood vessels, renal failure, and death.

Bacterial contamination. This rarely occurs. When it does occur, a life-threatening reaction is likely. Signs and symptoms of bacterial contamination include the rapid onset of chills, high fever, vomiting, diarrhea, very low blood pressure, and acute renal tubular necrosis.

Hypothermia. If blood is not warmed before a massive transfusion, hypothermia can cause ventricular arrhythmia and cardiac arrest.

Hyperkalemia. Certain patients can react to the potassium that slowly leaks into the blood plasma during storage. The patient may exhibit neuromuscular problems such as muscular weakness and paralysis. Heartbeat may be irregular (usually slowed), and death could result from cardiac arrest.

Microemboli. Transfusion of large volumes of banked blood may require filtering to remove debris accumulated from the breakdown of platelets, fibrin, and leukocytes during storage. This can lead to impaired oxygen transport ability in some patients who are administered large amounts of banked blood. The patient will exhibit breathing difficulties and pain in the extremities.

b. Delayed Effects. Adverse reactions can sometimes take weeks to show up. These are generally beyond the capability of the Medical NCO to correct.

Hemolytic. Delayed hemolytic reactions occur and usually result in extravascular removal of transfused cells from the circulation. This effect may take days or even weeks after the transfusion.

Viral Hepatitis. The occasional occurrence of post-transfusion hepatitis remains a serious consequence of blood transfusion. Albumin, plasma protein fraction, and immunoglobulin preparations are regarded as safe derivatives since hepatitis virus is usually inactivated or removed during preparation.

Others. Diseases such as malaria, acquired immune-deficiency syndrome (AIDS), hepatitis, and syphilis can be transmitted. Adequate donor screening is the only effective protection against these diseases presently.

3-20. GENERAL PRINCIPLES OF TRANSFUSION

Most of the rules for infusions also apply to transfusions. The rules below also apply to transfusions.
a. The venipuncture should be started before or at the same time the blood component is being obtained. This will allow the transfusion to begin immediately after the blood component has arrived and minimize the risk of improper storage.

b. The administration set should be cleared of air before venipuncture. Venipuncture can be performed with a needle attached to a syringe or attached directly to the blood administration set.

c. Red blood cells or whole blood should be administered using a needle of 18 gauge or larger. Other blood products such as platelets, cryoprecipitate, fresh frozen plasma, and albumin can be administered through smaller needles.

d. Warming of blood may be necessary if large amounts of blood are being transfused at a rapid rate.

e. Identification of the blood product at time of transfusion requires:

   (1) Check the ABO group and the Rh type on the label of the blood container to be certain it agrees with the compatibility record (that portion of the patient's hospital record that shows his blood type and other pertinent information).

   (2) Check the number on the label of the blood container to be certain it agrees with the compatibility record.

   (3) Check the blood compatibility record for the patient's name and hospital number.

   (4) Check the name and hospital number on the patient's wrist identification band against the information on the compatibility record.

   (5) When possible, ask the patient to identify himself by stating his name. 

   NOTE: Never ask, "Are you Mr. ________?"

   (6) The person who identifies that the correct blood product is being administered to the patient should then sign the compatibility record, and that record should be placed in the patient's chart at the completion of the transfusion. Do not begin the transfusion until any discrepancies in the above information are resolved.

3-21. BLOOD TESTS

The results of blood examinations are required to definitely rule out practically every disease. A physician would hesitate to declare a patient free from a disease until certain blood tests have been performed and the results of these tests can be included with the patient's health examination by other means. Even if the specific suspected disease is not expected to produce changes in the patient's hematologic (or blood picture) profile, this fact is required to support diagnosis. Blood tests are normally
ordered by the physician and completed in a clinical hematology laboratory. The Medical NCO should be aware of the commonly ordered tests and how some of the test results may indicate or point toward disease diagnosis. Most blood changes do point toward disease. The more common blood examinations are frequently all that are required for a patient. Their chief purpose is to indicate whether more detailed hematologic procedures are required. Listed below are some of the commonly performed tests you might expect to encounter in a clinical setting. The tests to be discussed here are the complete blood count (CBC), hematocrit, hemoglobin, sedimentation rate, partial thromboplastin time, and prothrombin time. There are many others. The selection of the test(s) will depend on the suspected disease, physician's preference, and the laboratory facilities.

a. Complete Blood Count. The complete blood count (CBC) includes the red blood count and the white blood cell count. These may be done either by using manual or by using automated methods.

(1) The red blood cell count (RBC) results in million RBCs per cubic millimeter in the sample. The normal values are 4.2-5.4 million RBCs per cubic millimeter for adult males and 3.6-5.0 million RBCs per cubic millimeter for adult females. To perform the test, a sample of blood is diluted with a special isotonic solution. When the sample has been mixed enough, part of the sample is put into a ruled counting chamber. Five ruled sections are counted, and the RBC is calculated.

(2) When the total leukocytes (white blood cells (WBC+ white blood cells)) are counted, no distinction is made for the type of white cell (for example, lymphocyte, monocyte, and so forth). If distinction is required, further testing must be done. The normal range for adults is 4,500-11,500 per cubic millimeter. Leukocyte counting is usually done electronically, but can be performed manually. A blood sample is mixed with required solutions, and gentian violet is added for color. A measured sample is put into a ruled counting chamber. Four marked sections are counted, and the WBC is calculated.

b. Hematocrit (Packed Cell Volume). The hematocrit is the volume of erythrocytes expressed as a percentage of whole blood in a sample. An anticoagulant is added to a small blood sample, and the tube is tightly capped to avoid evaporation. The sample is placed on a centrifuge and turned for five to thirty minutes (depending on the method and equipment used). The red cell column is measured in height (millimeters) against the height (in millimeters) of the whole column. The normal hematocrit for males is between 40 and 54. For females, the normal range is between 38 and 47. A value below the patient's normal or below the normal range may indicate anemia. A higher reading may indicate polycythemia.

c. Hemoglobin. The hemoglobin concentration in the blood bears a direct relationship to its oxygen carrying capacity. Because of the relationship, this test is performed on practically every patient, especially for suspected diseases associated with anemia. There are several ways to measure hemoglobin. The most widely used
and recommended method uses cyanide compounds to convert the hemoglobin. This process will eventually result in a compound called "cyanmethemoglobin". The hemoglobin content can then be determined. The use of cyanide compounds in this process increases the danger of accidental poisoning in the laboratory. Proper ventilation and protection for the technician must be available. The normal values are 14-17 grams hemoglobin (per deciliter) for adult males and 12-16 grams hemoglobin (per deciliter) for adult females.

d. **Erythrocyte Sedimentation Rate.** The erythrocyte sedimentation measures the rate at which the red blood cells settle out of the cellular-plasma suspension. The rate is usually increased in inflammatory infections, toxemia, cell or tissue destruction, severe anemia, active tuberculosis, syphilis, acute coronary thrombosis, rheumatoid arthritis, and malignant processes. The rate is generally decreased by sickle cell anemia, polycythemia, hypofibrinogenemia, and certain drugs. The procedure is to place a measured amount of anticoagulated blood in a tube and measure the distance the erythrocytes fall within a given time interval. Normal values are 0-9 millimeters for adult males and 0-20 millimeters for adult females. This test is inconclusive. It indicates the need for further testing. In some cases, such as acute rheumatic fever or congestive heart failure, the sedimentation rate has remained within normal limits.

e. **Partial Thromboplastin Time.** The partial thromboplastin time is the most useful screening method for detecting blood coagulation disorders. This procedure tests all three stages of blood coagulation and can show abnormalities in almost all of the clotting factors. Freshly collected blood is combined with certain compounds and observed for clot formation. Using most commercially prepared and some laboratory prepared compound, the clot should form in less than 35 seconds to be considered normal.

f. **Prothrombin Time.** The prothrombin time procedure detects abnormalities in the clotting time in some stages of the clotting process. If certain amounts of thromboplastin, calcium, and citrated plasma are carefully mixed under controlled conditions, fibrin strands will normally form within seconds. The time between the addition of plasma and the formation of the fibrin web is read. Normal values are 12 to 15 seconds. The prothrombin activity of the patient's plasma has important significance in diseases of the liver, in vitamin K deficiency, and in the use of dicumarol as an anticoagulant.

**Section III. INFUSION PROCEDURES**

**3-22. INTRODUCTION**

The intravenous infusion is often started by the Combat Medical Specialist or the Medical NCO in the field during a battle situation. The following method is essentially a review of the technique that was taught during medical training. This procedure requires practice under the supervision of a trainer who is experienced in the procedure. Mastery of the following material should not be interpreted as mastery of this task. It cannot substitute for hands-on supervised training and practice.
3-23. EQUIPMENT REQUIRED FOR THE INFUSION

The equipment used for both the infusion and the transfusion have many similarities and some differences. The equipment for the infusion is normally available in the field. Usually, the transfusion setup is available where blood products are administered.

a. Containers. There are three types of fluid container systems in current use, the closed system, the open system, and the plastic bag. (See Figure 3-1.)

![Figure 3-1. Containers for infusion solutions.](image)

(1) Closed system. The closed system bottle has an air vent through which medication may be added. A filter must be removed and then replaced. The sterility of the solution can be destroyed by careless handling of this filter.

(2) Open system. The open system bottle draws in added medication by vacuum, so this vacuum must be carefully maintained. The level of fluid remaining in the bottle is easily noted in both the open and closed systems.

(3) Plastic bag. The plastic bag has a port for adding the medication, but has no vacuum. Special care must be taken to be sure that the set is clamped off and medication is well mixed to prevent the patient from getting a toxic dose of the medication. It is difficult to judge the fluid remaining in the bag because it collapses as the fluid is withdrawn. Figure 3-2 shows medication being added to the three systems.
b. **Drip Chamber.** The drip chamber measures the rate of flow, as ordered by the doctor. There are several types of chambers. An example is shown in figure 3-3.

![Drip Chamber Diagram](image)

Figure 3-3. A drip chamber.

c. **Tubing.** The tubing and clamp are part of the administration set. There is enough tubing to allow an ambulatory patient to move around.

d. **Filters.** Some filters are already in the administration set and some must be attached separately. The type of filter used will depend on the solution being infused.
e. **Spikes.** Each type of system has a spike, which must be inserted into the fluid container. After this is done, the line must be cleared of all air. This is done by gradually lowering the tubing from the fluid container until the whole line is filled with fluid. All air must be forced from the tubing. Then the tubing is clamped off. Sterility must be maintained throughout the assembly process.

f. **Needle.** The size and type of needle will depend on the fluid infused and the local SOP. Sizes used are 14, 16, and 18 gauge (a lower number indicates a larger bore). A commonly used needle is the butterfly type with plastic wings. Some needles allow the catheter to be inserted with the needle while some have over-the-needle catheters. Some examples are shown in figure 3-4.

![Figure 3-4. Winged-tip needle. "Butterfly" (with tubing and adaptor).](image)

g. **Adhesive Tape.** The needle/catheter must be taped in place to prevent dislodging or vein irritation. Tape application will depend on the type of needle/catheter used.

h. **Constricting Band.** Any firm strip may be used. Examples are rubber tubing, cravats, or a blood pressure cuff. The band must remain in place no longer than two minutes.
i. **Antiseptic and 2 x 2 Gauze.** The patient’s skin must be cleansed at the venipuncture site, both before and after venipuncture. Antimicrobial ointment is usually applied at the site before taping the needle/catheter in place. Figure 3-5 shows an infusion in place.

![IV Bottle Image](image)

Figure 3-5. Infusion in place.

**3-24. PROCEDURE FOR VENIPUNCTURE**

a. Explain the procedure to the patient. If the patient is conscious and objects to the procedure for religious or other reasons, no further attempt should be made. If the patient is unconscious, consent is implied, and the venipuncture may proceed.

b. Assemble and set up the equipment. (See paragraph 3-23 for equipment).

c. Wash your hands.

d. Select an infusion site on the uninjured arm. Site should be at the most distal and accessible vein. Distal pulse should be present.
e. Apply the constricting band above the site and palpate for a fairly straight vein which lies on a hard surface. Vein should feel springy to palpation. Avoid sites near joints.

f. Cleanse the selected site and instruct the patient to clench and unclench his fist several times to improve venous distention.

g. Remove protective cover from catheter/needle unit without contaminating the needle.

h. Apply gentle pressure on the vein about one inch below the injection site and pull the skin taut.

i. Position the needle at a 20- to 30-degree angle and in the direction of the venous flow.

j. Insert needle and decrease the angle until almost parallel to skin surface. Aspirate for blood backflow or note blood in the flash chamber. If the first attempt is unsuccessful, pull the needle back slightly (but not above the flesh surface) and direct the needle point into the vein again. If this second attempt is unsuccessful, release the constricting band and withdraw the needle.

k. Remove the constricting band. Press the skin lightly over the catheter to constrict the vein and prevent excessive blood loss into the catheter. This procedure should be attempted again in another place.

l. Using your dominant hand, remove the protective cover from the needle adaptor and connect it quickly and tightly to the catheter hub.

m. Remove your other hand from the hub, release the clamp and adjust the flow. Check for infiltration.

n. Clean the area around the venipuncture and place ointment/dressing IAW local SOP. Tape the looped tubing securely to the patient’s arm.

3-25. DISCONTINUE AN INTRAVENOUS INFUSION

a. Introduction. An infusion must be stopped if there are complications beyond the capabilities of the Medical NCO. The infusion will be discontinued at the physician’s order.

b. Procedure to Discontinue.

   (1) Explain to the patient why the infusion is being discontinued and tell him what you are doing while you are working.
(2) Assemble the needed supplies-2 x 2 gauze, self-adhesive bandage, antiseptic.

(3) Turn off the solution flow.

(4) Remove all tape at the venipuncture site.

(5) Open and place a 2 x 2 gauze at the infusion site.

(6) Hold the site steady while gently removing the catheter. Do not apply pressure.

(7) Hold or instruct the patient to hold the gauze at the infusion site for 2 to 3 minutes to avoid hematoma. If infiltration is present, elevate extremity on a support.

(8) Apply a self-adhesive bandage.

(9) Record the amount left in the bag, the amount of fluid received by the patient, and the time the infusion was discontinued. Record any problems.

3-26. SPECIAL CONSIDERATIONS FOR TRANSFUSIONS

a. **Introduction.** Most of the requirements for the intravenous infusion also apply to the blood or blood component transfusion. There are some additional points that should be noted.

b. **Equipment.** The needles used are no smaller than 18 gauge (and frequently a larger gauge). A special administration set with filter(s) is required for most blood products.

c. **Typing.** Unless time and/or access to laboratory services are restricted, all patients should be typed, and the blood used should be cross-matched on all necessary factors. If the transfusion is needed immediately, type O Rh-negative packed red blood cells may be used. In this case, the patient must be checked constantly for hemolytic reaction during the transfusion.

d. **Storage.** Whole blood, with a preservative added, has a maximum allowable storage time (shelf life) of 35 days. In comparison, many of the parenteral solutions can be stored indefinitely (or at least for several years). During this storage, time the blood must be kept at 1°C to 6°C. This temperature is beyond the capabilities of most field refrigeration units. When a blood unit is delivered for use, it should not stand unnecessarily at room temperature. Delayed transfusion will add to the possibility of bacterial growth. If the blood unit must be kept at a field location and adequate refrigeration is not available, it should be stored in a styrofoam container with a cloth divider covered with a bag of ice.
e. **Rejecting Donor Blood.** If a blood unit appears abnormal in any way, it should not be used. The blood unit should not be used if:

1. The blood unit looks purple or brown.
2. Clots are visible.
3. There is an obvious breakdown of blood cells.
4. There is leakage from the container.

f. **Warming of Blood.** In cases where a large amount of blood is to be transfused at one time, the blood will need to be warmed. If too much cold blood is transfused at once, the patient can go into shock caused by hypothermia. Examples of blood warming coils are shown in Figure 3-6. Use of these coils should be directed by experienced personnel.

![Figure 3-6. Example of warming coils.](image)

Section IV. **VENOUS CUTDOWN**

3-27. **INTRODUCTION**

The venous cutdown is a minor surgical procedure normally done by a physician. The following information is presented for the Medical NCO so that you will be acquainted with the method. You may be called upon to assist the physician in maintaining sterility of the equipment and in caring for the patient following the procedure.
3-28. REASONS FOR USING THE VENOUS CUTDOWN

If an external site for the venipuncture cannot be located, a venous cutdown can be required. This situation may occur when a patient's veins have collapsed. If the patient is in shock, very thin, or in poor physical condition, a site for venipuncture may not appear. By doing a venous cutdown, the catheter can be inserted directly into a vein, and intravenous therapy can be started.

3-29. VENOUS CUTDOWN PROCEDURE

The following is a brief discussion of the venous cutdown procedure. You will perform only those actions that the physician tells you to perform.

a. Equipment and Supplies Used in Venous Cutdowns are:

   (1) Sterile gloves.
   (2) Scalpel handle and blades.
   (3) Suture materials.
   (4) Hemostats.
   (5) Scissors (vascular and suture).
   (6) Supplies for prepping and dressing the wound area.
   (7) Intravenous setup.
   (8) Sterile towels, mask.
   (9) Splint, if required.
   (10) Other supplies and equipment as required by physician (and available).

b. Site. Several sites may be chosen depending on the condition of the patient and the fluid to be infused. Some suggested sites are the:

   (1) Basilic vein above the elbow.
   (2) Basilic vein below the elbow.
   (3) Saphenous vein above the ankle.
   (4) Cephalic vein below the elbow.
c. **Procedure for the Cutdown.**

1. Assemble the equipment and supplies.
2. Wash your hands.
3. Explain the procedure to the patient.
4. Prepare and stabilize the site.
5. Apply/inject a local anesthetic so the patient will not feel the incision.
6. Make a transverse cut and dissect the tissue until the vein is visible. (See figure 3-7.) Using a curved hemostat, gently spread the underlying tissue to fully expose the vein.

![Figure 3-7. Open incision for venous cutdown.](image)

7. Lift the vein and put two threads of suture under it. (See figure 3-8.)

![Figure 3-8. Thread under vein.](image)
(8) Tie both threads and pull in opposite directions. Leave enough vein between the two ties to insert the catheter.

(9) Nick the vein with a scalpel (or cut with vascular scissors). (See figure 3-9.)

(10) Insert the proper size plastic catheter into the exposed vein (to near the catheter hub) and secure. (See figure 3-10.)
(11) Attach catheter to previously prepared infusion set and close the wound.

(12) Suture the incision and apply an antibiotic ointment. (See figure 3-11.)

Figure 3-11. Suture incision.

(13) Apply a sterile dressing and tape the catheter in place.

(14) The procedure must be documented (usually in Nursing Notes). Physician will specify when to remove the skin sutures.

(15) Outer tape should show catheter size, date and time of insertion, and inserter’s initials.

Continue with Exercises
EXERCISES, LESSON 3

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the exercise, by completing the incomplete statement, or by writing the answer in the space provided at the end of the exercise.

After you have completed all the 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. What is the difference between the two major types of intravenous fluids?

2. An example of a hydrating solution that contains no calories is:
   a. Normal saline.
   b. D5W.
   c. D5RL.
   d. Intralipid

3. If you can see suspended particles in an intravenous solution, you should:
   a. Use a filter on the administration set.
   b. Infuse at a slower rate.
   c. Use a larger bore needle.
   d. Discard the solution.
4. Scalp veins are often used as venipuncture sites for:
   a. Elderly persons.
   b. Women.
   c. Infants.
   d. Adult males.

5. The death of an intravenous therapy patient could easily result from
   a. Use of peripheral catheters.
   b. Using a small bore needle.
   c. Infiltration.
   d. An air embolism.

6. The physician’s order states that 500 milliliters of D5W should be infused over a
four-hour period. Your infusion set delivers fifteen drops per milliliter. You will set
the drip rate for ____ drops per minute.

7. The nurse started the intravenous infusion hurriedly just before you arrived. When
you walk in, he hands you the patient's chart telling you to check and possibly
reset the drip rate while he administers medication. The administration set is
giving ten drops per milliliter. The physician has ordered that the patient receive
one thousand milliliters of the intravenous solution over a four-hour period. The
drip rate is now set at thirty-five drops per milliliter. You should reset the drip rate
to ____ drops per milliliter.
   a. 42.
   b. 65.
   c. 24.
   d. Leave the drip rate as now set.
8. Blood cells in a unit of blood will all be dead within:
   a. 10 days.
   b. 21 days.
   c. 120 days.
   d. 24 hours.

9. One major advantage of using Normal Human Serum Albumin is that it:
   a. Draws fluid into the tissues from the blood vessels.
   b. Does not require refrigeration.
   c. Contains no water.
   d. Contains many red blood cells.

10. Although a blood product is usually transfused through the larger veins, it can be administered through ____ other routes.
    a. 8.
    b. 4.
    c. 6.
    d. 3.

11. An example of a donor transmitted disease transmitted from a blood transfusion is:
    a. Hypothermia.
    b. Immunoglobulin.
    c. Rubeola.
    d. Malaria.
12. Blood that is being transfused should be warmed if:
   a. Massive amounts are being transfused at once.
   b. The blood unit is cold.
   c. Other solutions are being infused at the same time.
   d. The patient needs only minor surgery.

13. The transfusion information on a patient's record should be signed by:
   a. The head nurse.
   b. The physician.
   c. The person who gives the transfusion.
   d. The blood bank executive officer.

14. Common blood tests are performed mainly for the purpose of:
   a. Diagnosing disease in the absence of a medical physician.
   b. Determining a patient's food allergies.
   c. Determining a need for further testing.
   d. Administering special drugs.

15. The needle for venipuncture should be inserted at an angle of:
   a. 90 degrees.
   b. 20 to 30 degrees.
   c. 5 to 10 degrees.
   d. 180 degrees.
16. When an intravenous infusion is discontinued, you should record:
   a. Physician's name, your name, and when you finished.
   b. Why you stopped the infusion.
   c. Amount infused, amount left, time finished, and problems.
   d. When the infusion was started, how long it took, and the drip rate used.

17. Medication added to an intravenous container must be:
   a. A non-irritating type.
   b. Very cold.
   c. Mixed thoroughly with the solution.
   d. Added by the physician only.

18. If venipuncture is used for blood, the needle used must be:
   a. 18 gauge or larger.
   b. 20 gauge or smaller.
   c. Blunt point.
   d. A special type used only for blood.

19. The proper temperature for storage of whole blood units is:
   a. One to six degrees Fahrenheit.
   b. One to six degrees Celsius (centigrade).
   c. Six to twelve degrees Celsius (centigrade).
   d. Normal body temperature.
20. A venous cutdown might be indicated when the patient is:
   a. Very fat.
   b. Very thin.
   c. An athlete.
   d. Somewhat nervous.

21. A venous cutdown requires the use of a:
   b. Scalpel.
   c. Very sharp needle.
   d. Magnified scope.

22. A venous cutdown should be done by a physician because it is considered:
   a. Clean, but not sterile.
   b. Drug dependent.
   c. Major surgery.
   d. Minor surgery.

23. Suggested sites for a venous cutdown include:
   a. Above and below the elbow.
   b. The groin area.
   c. Under the armpit.
   d. The buttocks.
24. A local anesthetic is injected for a venous cutdown to:
   a. Deaden feeling at incision site.
   b. Sterilize the open wound.
   c. Deaden feeling in the vein.
   d. Apply the antibiotic ointment.

25. During a venous cutdown, the vein is tied off:
   a. Above the vein incision.
   b. Below the vein incision.
   c. Above and below the vein incision site.
   d. Using a hemostat.

Check Your Answers on Next Page
SOLUTIONS TO EXERCISES, LESSON 3

1. The infusion solution arrives ready to use from the manufacturer while the admixture has certain drugs added for the patient by the Pharmacy Sterile Products Section. (paras 3-2a and 3-2b)

2. a (para 3-3b(2))

3. d (para 3-7)

4. c (para 3-9b)

5. d (para 3-11e)

6. 31 (7500 divided by 240) (para 3-13)

7. a (10,000 divided by 240) (para 3-13)

8. c (para 3-15)

9. b (para 3-16c(1))

10. d (para 3-17)

11. d (para 3-19a(6))

12. a (para 3-20d)

13. c (para 3-20e(6))

14. c (para 3-21)

15. b (para 3-24i)

16. c (para 3-25b(9))

17. c (para 3-23a(3))

18. a (para 3-26b)

19. b (para 3-26d)

20. b (para 3-28)
21. b (para 3-29a(2))
22. d (para 3-27)
23. a (para 3-29b)
24. a (para 29c(5))
25. c (para 3-29c(8))

End of Lesson 3