

## LESSON

1-13

# Blood Collection: Routine Venipuncture

## LESSON OBJECTIVES

After studying this lesson, the student will:

- Explain the venipuncture procedure.
- Select the equipment necessary to perform a venipuncture.
- Apply a tourniquet.
- Select a proper venipuncture site.
- Perform a venipuncture.
- List the safety precautions to be observed when performing a venipuncture.
- Discuss factors that can affect the quality of the blood sample obtained by venipuncture.
- Name three common anticoagulants in vacuum tubes and state why they are used.
- Define the glossary terms.

## GLOSSARY

*basilic vein* / large vein on inner side ("pinky" side) of arm

*cephalic vein* / a superficial vein of the arm (thumb side) commonly used for venipuncture

*gauge* / a measure of the diameter of a needle

*hematoma* / the swelling of tissue around a vessel due to leakage of blood into the tissue

*hemoconcentration* / increase in the concentration of cellular elements in the blood

*hemolysis* / rupture or destruction of red blood cells resulting in the release of hemoglobin

*hypodermic needle* / a hollow needle used for injections or for obtaining fluid specimens

*lumen* / the open space within a tubular organ or tissue

*median cubital vein* / a superficial vein located in the bend of the elbow (cubital fossa) that connects the cephalic vein to the basilic vein

*palpate* / to examine by touch

*phlebotomy* / venipuncture; entry of a vein with a needle

*syringe* / a hollow, tube-like container with a plunger, used for injecting or withdrawing fluids

*tourniquet* / a band used to constrict blood flow

*vein* / a blood vessel that carries deoxygenated blood from the tissues to the heart

*venipuncture* / entry of a vein with a needle; a phlebotomy

## INTRODUCTION

The most common method of obtaining blood for laboratory examination is by venipuncture. The venipuncture is a quick way to obtain a large sample of blood on which many different analyses can be performed. In a venipuncture, also called a phlebotomy, a superficial vein is punctured with a hypodermic needle and blood is collected into a syringe or vacuum tube.

Performing a venipuncture involves several important steps that must be thoroughly understood before the procedure is attempted:

- Observing Standard Precautions and other safety measures throughout procedure
- Selecting the proper equipment
- Preparing the patient for venipuncture
- Selecting and preparing the puncture site
- Applying the tourniquet
- Obtaining the blood
- Caring for the puncture site and observing the patient for adverse reaction

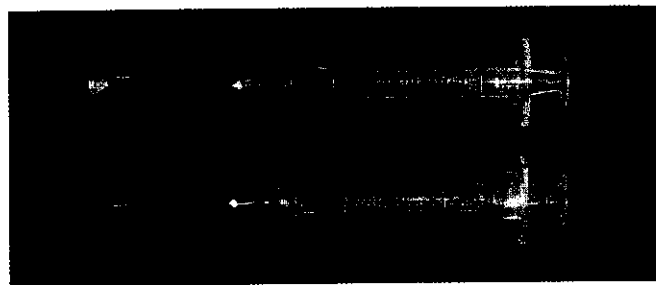
The venipuncture is a safe procedure when performed correctly by a trained worker. The venipuncture must be performed carefully to preserve the condition of the vein. Much observation and practice is required to become skilled and self-confident in the art of venipuncture.

## MATERIALS AND SUPPLIES FOR VENIPUNCTURE

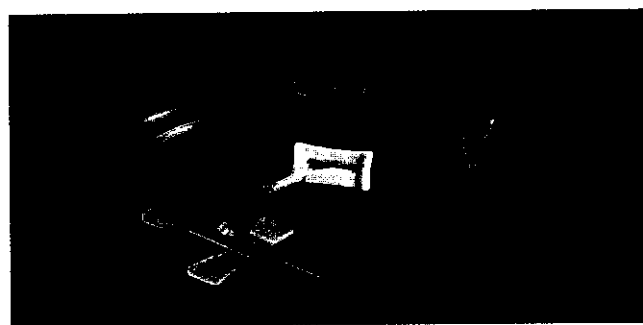
Venipuncture can be performed using a vacuum tube safety needle/tube holder assembly (Figure 1-76), a safety syringe and needle (Figure 1-77), or butterfly needle and holder (Figure 1-78). Other materials required for venipuncture include blood collecting tubes, alcohol swabs, sterile gauze, tourniquet, and band-aid or small bandage (Figure 1-79). Venipuncture supplies



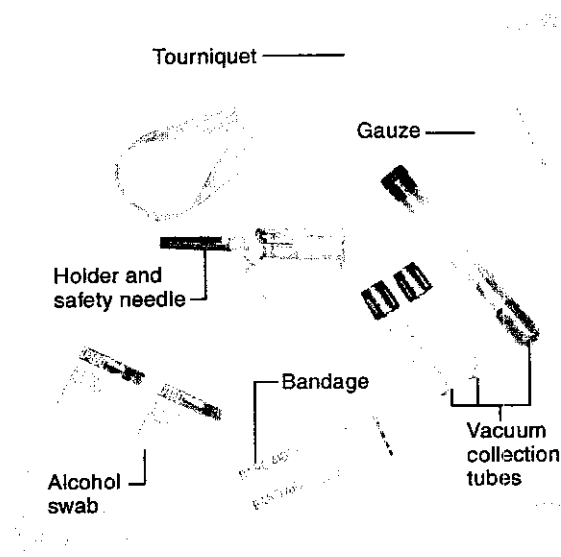
**FIGURE 1-76** Vacuum tube system: safety needle, disposable needle holder, and vacuum collection tube  
(Photo courtesy of Smiths Medical ASD, Inc.)



**FIGURE 1-77** Safety syringe with sliding plastic sheath covering needle



**FIGURE 1-78** Butterfly needle  
(Photo courtesy of Smiths Medical ASD, Inc.)

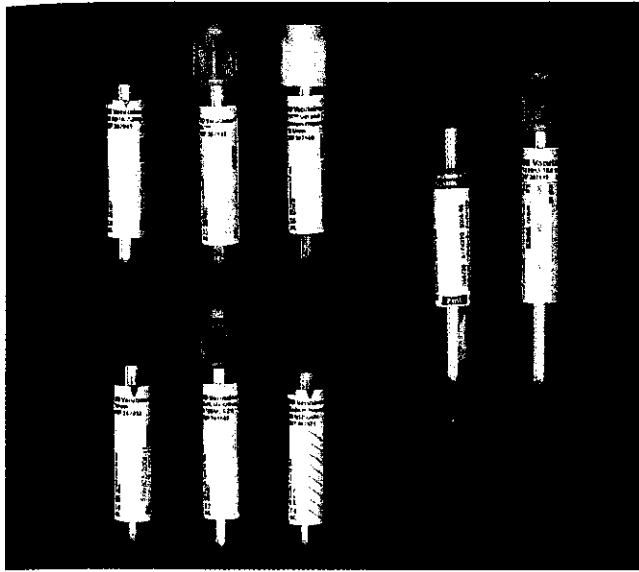


**FIGURE 1-79** Venipuncture supplies

should be organized into a portable phlebotomy tray, so that they will be readily available to the phlebotomist.

## Needles

The length and gauge (diameter) of the needle used for venipuncture varies according to the procedure or preference of the phlebotomist. Venipuncture needles can be from  $\frac{3}{4}$  inch to  $1\frac{1}{2}$  inches in length. For routine venipuncture, 21 gauge  $\times$  1 inch needles are used. (The higher the gauge number, the smaller the



**FIGURE 1-80** Vacuum tubes with color-coded tube stoppers

needle diameter.) Larger diameter needles are required for collection of blood donor units.

In response to the mandate to use safer methods to minimize or prevent accidental needlesticks, manufacturers of phlebotomy supplies have modified needle and holder systems to create several *safe* designs. Improved designs are continually being developed. One system uses safety needles that have internal blunting, meaning that the needle is made safe before it is removed from the vein. Other systems use a standard needle and disposable needle holder with a needle guard that snaps or slides over the exposed needle after the venipuncture, covering the needle until the entire unit is discarded (Figures 1-76 and 1-77). Safety needles or needle holders must be used when performing venipuncture.

## Vacuum Tubes and Anticoagulants

Vacuum tubes, blood collecting tubes from which most of the air has been evacuated, are made in a variety of types and sizes. Tubes can be sterile or nonsterile, and glass or plastic. Each tube is

manufactured to draw a specific volume of blood. Tube sizes commonly used are 3, 5, 7, and 10 mL. Tube stoppers are color-coded to designate which, if any, anticoagulant is present in the tube (Figure 1-80). Tubes with anticoagulant contain the exact amount required for the amount of blood the tube will draw. It is important that tubes be filled to their stated capacities because an improper ratio of anticoagulant to blood can alter cell morphology and cause erroneous test results, especially in coagulation tests. The laboratory procedure manual should include a list of tests performed and the type of vacuum tube that should be used for each.

Table 1-34 is an abbreviated guide to selecting vacuum tubes. Red-stoppered tubes contain no anticoagulant and are used for tests that require serum, such as most blood chemistries. Tubes with red/gray stoppers, called serum separator tubes, contain gel clotting activators that accelerate clotting. After the tubes are centrifuged, the gel is located between the serum and the clot, keeping them separate.

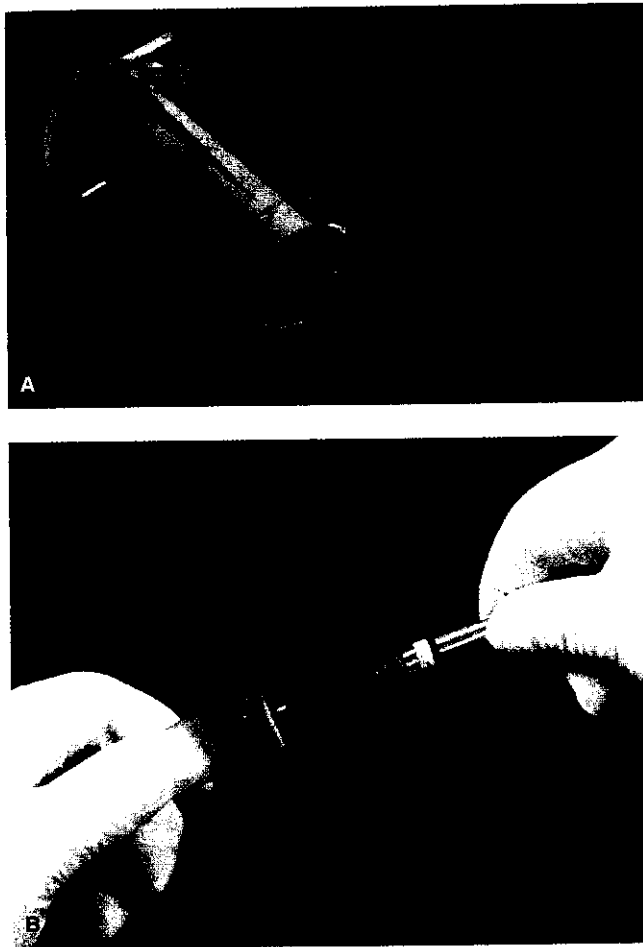
Procedures that use plasma require that blood is collected with a specific anticoagulant. For example, tubes with lavender stoppers contain EDTA, which is the anticoagulant used for most hematology studies, such as cell and differential counts. Light blue-stoppered tubes contain sodium citrate, the anticoagulant used for most coagulation studies. Tubes with dark green stoppers contain heparin and are used for several tests in chemistry and hematology, but these tubes should not be used if stained blood smears are to be prepared from the specimen. Gray-stoppered tubes containing potassium oxalate anticoagulant and sodium fluoride (to inhibit glycolysis) are used for certain glucose tests and legal alcohol.

## PERFORMING A VENIPUNCTURE USING A VACUUM TUBE SYSTEM

A widely used method of collecting venous blood is the vacuum-tube system consisting of a double-ended needle, needle holder, and vacuum tubes. The short rubber-sheathed end of the needle is threaded into the needle holder and is used to pierce the stopper in the vacuum tube during blood collection (Figure 1-81). The long end of the needle, covered by a removable plastic cap, is used to puncture the vein.


**TABLE 1-34.** Guide for selecting vacuum tubes

STOPPER COLOR	ANTICOAGULANT IN TUBE	EXAMPLES OF USE
Red	None	Tests that require serum, such as most blood chemistries and serology tests
Red/gray	None	Serum-separator tube; used for tests that require serum
Lavender	EDTA	Most hematological tests, blood-typing
Green	Heparin	Some special chemistry tests, certain lymphocyte studies, lupus erythematosus test
Light blue	Sodium citrate	Most coagulation studies
Gray	Potassium oxalate	Certain glucose tests, legal alcohol
Black	Buffered sodium citrate	Westergren ESR

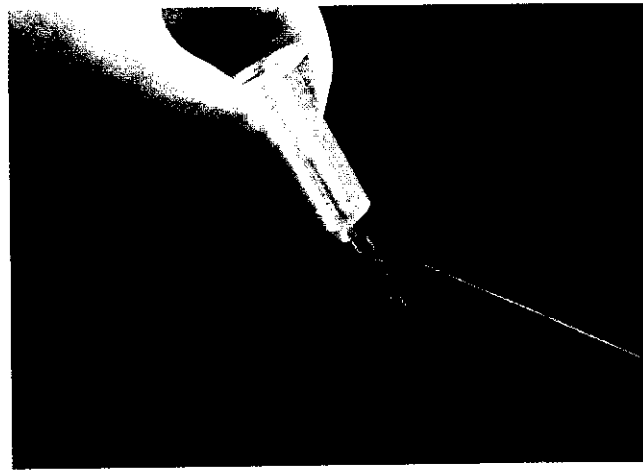


**FIGURE 1-81** Vacuum tube blood collecting system:  
(A) disposable needle holder with needle safety guard;  
(B) inserting sheathed short end of needle into needle holder  
(Courtesy of Smiths Medical ASD, Inc.)

## Safety Precautions


 Standard Precautions must be observed and gloves must be worn by the phlebotomist when performing all venipunctures. It is best to use gloves without talc to avoid contaminating collection tubes. The phlebotomist should wear personal protective equipment (PPE) such as a buttoned, fluid-resistant laboratory coat and face protection. Students learning to perform venipuncture must be supervised by a qualified instructor.

Used needles must never be recapped but should be immediately discarded into a biohazard sharps container (Figure 1-82). Venipuncture products with enhanced safety designs should be used. Several types of safety needles, needle holders, and syringes are available (see Figures 1-77 and 1-81). The correct use of engineering controls such as safety needles should decrease the incidence of accidental needlesticks and possible transmission of bloodborne pathogens associated with needlesticks. However, workers must continue to be aware of the potential for injury since no system is 100% safe 100% of the time.



**FIGURE 1-82** Disposable of used venipuncture assembly into sharps container (Courtesy of Smiths Medical ASD, Inc.)

## Quality Assessment

 Proper specimen collection is the first step in ensuring quality test results on blood samples. The phlebotomist must properly identify the patient, select the correct tubes for blood collection, collect the specimen under the proper conditions, and deliver the specimen to the testing site within the specified time limits. Specimen quality can be compromised because of improper venipuncture technique or the improper handling, transport, or storage of the specimen. Some test procedures require special collection and handling, such as immediate placement of the blood specimen on ice. Specimen collection parameters required for each laboratory test are described in the laboratory procedure manual and must be followed.

Two conditions that can occur as a result of improper blood collection technique are hemolysis and hemoconcentration. Either of these two conditions will adversely affect test results. Hemolysis, the rupture of red blood cells, can cause erroneous hematology and blood chemistry results. Hemolysis can be caused by using a small gauge collection needle or when blood flow through the needle is slowed because of improper positioning of needle in vein. Hemoconcentration can occur when the tourniquet is left on too long before the venipuncture is performed. This can cause localized stasis in the vein and artificially alter the concentration of blood constituents.

## Selecting the Equipment

Phlebotomy supplies should be placed within easy reach of the phlebotomist. A portable phlebotomy tray can hold all supplies (Figure 1-83), including a sharps disposal container, gloves, and face protection. The needle and safety needle holder should be assembled and the correct vacuum tube(s) selected.

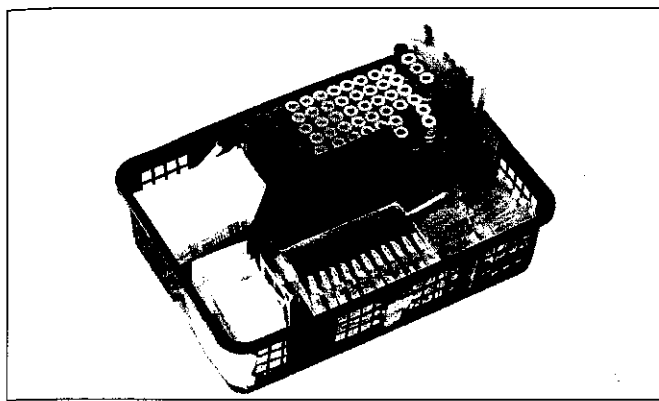


FIGURE 1-83 Portable phlebotomy tray

## Preparing the Patient

The patient should be identified by asking the patient name and verifying the name on the laboratory request form. If the patient is hospitalized, the patient identification band must be checked against the request form and any preprinted labels. For some critical procedures, such as collecting blood for pretransfusion testing, the phlebotomist usually places an additional identification wristband on the patient that is coded to the blood-collection tubes.



FIGURE 1-84 Patient seated in phlebotomy chair with arm supports

The venipuncture procedure should be fully explained to the patient to minimize apprehension. The patient should be lying down or seated in a chair that has arm supports. The patient's arm must be fully extended and firmly supported so that it will remain still during the venipuncture (Figure 1-84). The phlebotomist should be trained in first aid procedures to be prepared for the occasional patient who might faint.

## Tying the Tourniquet

A tourniquet is applied to the arm to make the veins more prominent. Disposable tourniquets are preferred, because they eliminate the need to disinfect ones that come in contact with blood. The tourniquet is placed under the arm 3 to 4 inches above the elbow, and the two ends are stretched and crossed over the top of the arm (Figure 1-85). While tension is maintained on the ends, one side is looped and pulled halfway through. When the tourniquet is tied in this manner, it will release easily with a gentle pull on one end (Figure 1-86). *The tourniquet should never be tied tight enough to compromise circulation.* The tourniquet should be left in place for no more than 1 to 2 minutes.



FIGURE 1-85 Tying the tourniquet



**FIGURE 1-86** Release the tourniquet by pulling on one end (arrow)

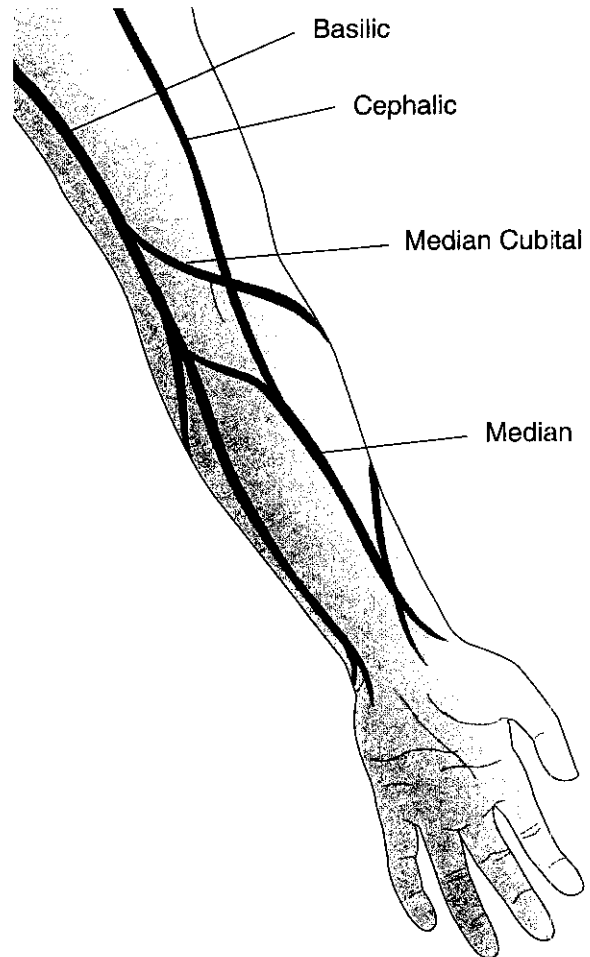
## Selecting the Venipuncture Site

The puncture site should be selected after inspecting both arms to locate the best vein. The tourniquet can be applied to aid in selection of the puncture site, but it should be released while the site is cleansed, and retied before the puncture is performed. The veins most frequently used are the median cubital vein and the cephalic vein of the forearm; the basilic vein can also be used (Figure 1-87). The phlebotomist should palpate the vein by gently pressing the fingertip along the vein to determine its direction and estimate its size and depth (Figure 1-88). The vein will have a *bouncy* feel to it.

Veins that have scarring or bruising, or that have had recent venipuncture should not be used. Blood should not be collected from an arm with an intravenous line or from the arm of a patient who has had a recent mastectomy (breast removal) on that side.

## Preparing the Venipuncture Site

The venipuncture procedure is illustrated in Figure 1-89. The area around the puncture site should be cleansed thoroughly in a circular motion from the center outward with a 70% alcohol swab (Figure 1-89A). The site should then be allowed to air-dry or be wiped dry



**FIGURE 1-87** Veins commonly used for venipuncture (left arm shown)

with sterile gauze. Once the site is cleansed, it should not be touched again except to enter the vein with the sterile needle. If the vein must be palpated again, the skin must be recleansed.

## Obtaining the Blood

When the puncture site has been cleansed, the tourniquet should be reapplied to the arm, taking care that it does not touch the cleansed area. The needle/holder assembly should be held in one hand with the needle bevel facing up and the needle shaft lined up with the vein (Figures 1-89B and 1-90A).

The vein should be anchored by grasping the arm, placing the thumb on the vein about 1 inch below the puncture site and pressing and pulling the skin taut toward the phlebotomist. Holding the needle/holder at a 15° to 25° angle, the skin and vein should be entered in one smooth motion until the needle is in the lumen of the vein (Figures 1-89C and 1-90B). Penetration of the vein should be at a low angle to prevent piercing the bottom wall of the vein, and possibly causing a hematoma, or swelling. *If a hematoma begins to form during the procedure, the tourniquet should be immediately released, the needle withdrawn, and gauze and pressure applied to the puncture site.*

Once the needle is in the vein, the needle holder should be steadied with one hand while the vacuum tube is gently pushed



**FIGURE 1-88** Palpating a vein

onto the sheathed needle inside the holder, allowing blood to be drawn into the tube by vacuum (Figure 1-89D). When the tube is full, it is removed from the holder. If more than one tube is needed, the second tube is then pushed onto the needle in the holder (1-89E). The rubber sheath on the needle prevents blood leakage between tube changes. If more than one type of tube is to be filled, the *clot tube* (red-stoppered) must be filled first; tubes containing anticoagulant are filled last. Tubes containing anticoagulant should be inverted gently (not shaken) a few times immediately after filling to mix the blood with the anticoagulant. The last tube should be removed from the needle holder before the needle is withdrawn from the vein (Figure 1-89F)

### Completing the Venipuncture and Caring for the Patient

When the desired amount of blood has been obtained, the tourniquet should be released. (Or, once the vein is entered and good blood flow is obtained, the tourniquet can be released while the remainder of blood is collected.) The tourniquet is always released before the needle is withdrawn from the vein to prevent hematoma at the venipuncture site. As the needle is withdrawn from the vein, gauze should be immediately placed over the puncture site and pressure applied (Figure 1-87G). The patient should be instructed to press the gauze on the puncture site for 2 to 5 minutes with the arm extended to ensure that bleeding stops and a hematoma does not form.

The needle must not be recapped or removed from the needle holder by hand. The safety device must immediately be used to cover the needle so that an accidental needlestick is not possible. The unit is then discarded into a biohazard sharps container. The phlebotomist should then apply patient labels to the tubes in the presence of the patient. The labels must contain patient information, date and time of collection, and phlebotomist's name or initials. Tubes should not be pre-labeled to prevent the possibility of using a pre-labeled tube for the wrong patient.

The phlebotomist should check the venipuncture site and be sure that bleeding has stopped before leaving the patient. Most sites will stop bleeding within 2 to 3 minutes. A small bandage or band-aid can be applied to the site if necessary.

## PERFORMING A VENIPUNCTURE USING A SYRINGE

Syringes can be used for small, difficult veins that make routine venipuncture with vacuum tubes difficult. When using a syringe to perform a venipuncture, the phlebotomist should use syringes and/or needles designed with safety features to prevent needlesticks. Disposable syringe/needle units are available that have a sliding shield to cover the needle after use. Alternatively a safety needle with a protective sheath can be attached to a disposable syringe.

To use a syringe, the needle should be positioned firmly on the syringe so the bevel and graduations of the syringe face in the same direction. The syringe plunger should be pushed up and down to see that it moves freely. It should then be left pushed completely into the barrel so that no air remains in the syringe.

The syringe venipuncture procedure is the same as with the vacuum tube system except that instead of the vacuum tube drawing the blood automatically, the phlebotomist must steady the syringe with one hand while the other hand gently pulls back on the plunger to draw blood into the syringe. The needle should be observed while the syringe is filling to be sure it is not accidentally pulled out of the vein. After the syringe is filled, the needle is withdrawn from the vein and the blood can be transferred to a vacuum tube using a special safety adapter. The safety feature should then be activated, and the entire unit should be discarded into a biohazard sharps container.

## ATTENTION!

### ACTION TO TAKE IN CASE OF EXPOSURE INCIDENT

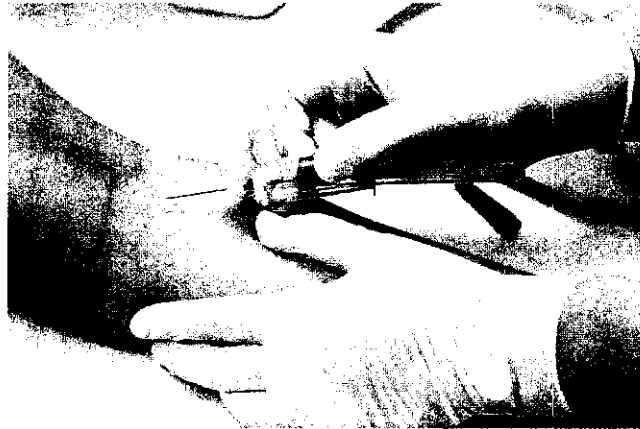


If you receive a needlestick or other injury from sharps, or if your eyes, nose, mouth, or broken skin are exposed to OPIM:

1. Immediately flood the exposed area with water, and clean skin with antiseptic soap and water.
2. Report accident immediately to supervisor, risk control officer, or other appropriate person.
3. Seek immediate medical attention.



A



B



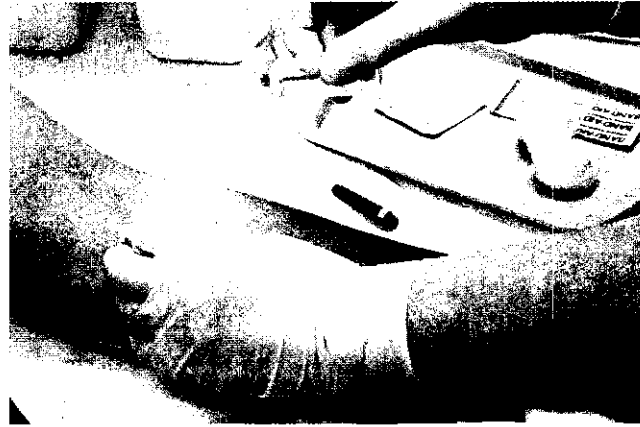
C



D



E



F



G

**FIGURE I-89** Performing the venipuncture. (A) Cleanse the puncture site with alcohol using a circular motion; (B) line up needle with vein; (C) pierce skin and vein in one smooth motion and insert tube into holder to puncture cap of vacuum tube; (D) allow tube to fill; (E) fill additional tubes, inverting tubes containing anticoagulant; (F) withdraw tube from needle before withdrawing needle from vein; (G) apply pressure to puncture site

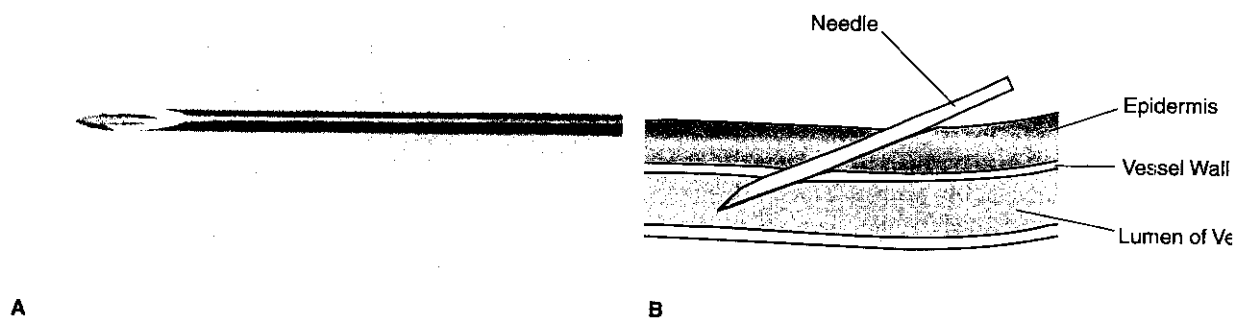


FIGURE 1-90 Close-up view of bevel of needle (A) and illustration of proper position of needle in lumen of vein (B)

### SAFETY Reminders

Review safety section before performing venipuncture.



Observe Standard Precautions when performing venipuncture.



Use safety devices such as self-sheathing needles.

Never reuse needles or syringes.

Do not recap needles; discard in appropriate sharps container.

Check venipuncture site before leaving patient.

### PROCEDURAL Reminders

Review venipuncture procedure before attempting venipuncture. *QA*

Identify patient by asking for a name and checking armband.

Be sure patient's arm is firmly supported before performing venipuncture.

Do not allow tourniquet to remain on the arm for more than 1 to 2 minutes.

Always release the tourniquet before removing the needle from the vein.

Release tourniquet immediately, withdraw needle, and apply pressure to puncture site with gauze if a hematoma begins to form.

Label filled tubes as soon as the venipuncture is completed, and before leaving the patient.

## CASE STUDY

Jerry was completing his fourth week of CLT internship at Pleasant Valley Hospital. All interns were required to collect blood each morning from eight to 10 patients before beginning their clinical rotation. Jeremy had completed his phlebotomy rotation the previous week, so he was collecting blood on his own (without supervision). One of the patients on his collection list was 72 years old. Jerry saw only one adequate vein in the patient's left arm but was unable to get blood when he attempted venipuncture.

1. What should Jerry do?
  - a. Stick the same vein again
  - b. Keep trying other veins until he is successful
  - c. Ask for assistance from an experienced phlebotomist
  - d. Discretely return the test request form to the stack of collections that are needed and go to his internship rotation assignment
2. Discuss factors that cause venipuncture to be difficult and how these venipunctures can be handled.

## SUMMARY

Venipuncture is a common method of obtaining blood for routine laboratory analysis. The procedure is safe when performed by trained phlebotomists. Venipuncture can be performed using a vacuum tube collecting system or a syringe. The phlebotomist must use the proper technique to obtain the blood and must also select and use the correct specimen tubes and handling conditions for each test ordered. This information is provided in the laboratory procedure manual.

The phlebotomist must follow Standard Precautions and wear appropriate PPE when performing venipuncture. The development of safety needles and safety collection devices has increased the safety level for the phlebotomist by decreasing the risk of accidental needlesticks. These safety devices must be used when performing venipuncture.

## REVIEW QUESTIONS

1. Why is a venipuncture performed?
2. What is the purpose of a tourniquet?
3. Name five precautions that must be observed when performing a venipuncture.
4. What are the steps in performing a venipuncture?
5. What is the most common venipuncture site?
6. Why must the tourniquet be released before removing the needle from the vein?
7. How should the puncture site be cared for after the needle is removed?
8. Explain briefly the vacuum system of obtaining venous blood.
9. What precautions should the phlebotomist take when performing a venipuncture to avoid exposure to blood?
10. Name three anticoagulants used in collecting blood. Which one is most commonly used in hematology?
11. Why is it important to verify patient identification before performing a venipuncture?
12. Define basilic vein, cephalic vein, gauge, hematoma, hemoconcentration, hemolysis, hypodermic needle, lumen, median cubital vein, palpate, phlebotomy, syringe, tourniquet, vein, and venipuncture.

## STUDENT ACTIVITIES

1. Complete the written examination for this lesson
2. Practice applying a tourniquet and locating suitable veins for venipuncture.
3. Practice performing a venipuncture as outlined in the Student Performance Guides.

## WEB ACTIVITIES

1. Use the Internet to find information on safety needles and venipuncture devices. Explain how each type protects the worker from accidental needlesticks.
2. Visit Web sites of agencies such as the Centers for Disease Control and Prevention, Occupational Safety and Health Administration, and National Institute for Occupational Safety and Health. Look for information on preventing needlestick or sharps injury. Try to find free brochures, powerpoint presentations, or other safety information that can be downloaded.