

EXERCISE 3: SKIN PUNCTURE ON INFANTS

Textbook: Chapter 11

Skills: Dry Lab

- Objectives:
1. State the composition of skin puncture blood and list tests that **cannot** be performed on skin puncture specimens.
 2. Describe, in detail, the proper site on the heel which must be selected for performing a heel puncture blood collection.
 3. State the maximum depth of the puncture site and the reasons for not exceeding this depth.
 4. Describe how to properly warm the heel and why this is important.
 5. Describe the appearance of an appropriate collection site.
 6. List 6 precautions involved in *selecting a site* for the heel puncture.
 7. List 5 precautions for *collection of the blood* from a heel puncture.
 8. List 5 additional precautions to protect the well-being of the infant.
 9. List the supplies needed for the heel puncture.
 10. Describe the proper procedure for performing the heel puncture.

Revised: August 21, 2002

Discussion

Composition of skin puncture blood

Blood obtained by skin puncture is a mixture of arterial blood (from arterioles), venous blood (from venules), and capillary blood, along with interstitial and intracellular fluids from the surrounding tissues. It contains a higher proportion of arterial blood than venous blood because of the pressure with which the arterial blood enters the capillaries. Composition of skin puncture blood, therefore, more closely resembles arterial blood than venous blood obtained by venipuncture.

Because skin puncture blood differs in composition from regular venous blood, reference (normal) values for certain tests will be different for skin puncture blood. The most notable differences are for glucose, which is higher in skin puncture blood; and total protein, calcium, and potassium, which are lower in skin puncture blood.

Tests that cannot be performed by skin puncture.

Although today's technology allows many tests to be performed on very small quantities of blood, and a wide selection of devices are available to make collection of skin puncture specimens relatively safe and easy, some tests cannot be performed on skin puncture specimens. These include erythrocyte sedimentation rate (ESR or Sed rate), most coagulation studies (PT, PTT, Fibrinogen), blood cultures, and tests that still require large volumes of serum or plasma.

Indications for performing skin puncture.

Skin puncture is the preferred method of obtaining blood from infants and children. Obtaining blood from infants and children by venipuncture is difficult and may damage veins and surrounding tissues. Because infants and young children have such a small blood volume, removing large quantities of blood can also lead to anemia. Large quantities removed rapidly can cause cardiac arrest. In addition, some tests such as neonatal screening tests for phenylketonuria (PKU) and other inherited diseases are designed to be performed on skin puncture blood only.

Site selection for skin puncture.

In general, skin puncture sites should be warm, pink, and free of scars, cuts, bruises or rashes. **Do not** choose a site that is cold, cyanotic or edematous.

The heel is the recommended site for collection of skin puncture specimens on infants less than 1 year old. However, it is important that the puncture be performed on an area of the heel where there is little risk of puncturing the bone, tendons or nerves.

Puncture of the bone can cause painful osteomyelitis or bone infection, as well as osteochondritis, inflammation of the bone and cartilage. Addition puncture through previous puncture sites may spread the infection.

Studies have shown that the calcaneus (heel bone) of premature infants may be as little as 2.4 mm below the skin surface on the bottom (plantar surface) of the heel and half that distance at the back (posterior curvature) of the heel.

For this reason, guidelines were developed to determine the safest areas, as well as optimal depth for performing heel puncture. Guidelines have been developed by NCCLS and are published in Document H4-A3 (National Committee for Clinical Laboratory Standards).

The location of the puncture site should be on the plantar surface medial to an imaginary line drawn posteriorly from the middle of the great toe to the heel, or lateral to a line drawn posteriorly from between the fourth and fifth toes to the heel. In almost all infants the bones, arteries, and nerves are not near these areas. On the inside (big toe side) of the heel is a posterior tibial artery near the curvature. *The outside of the heel (little toe side) is the primary area of choice in heel puncture.*

The inside (big toe side) of the heel can be used as long as puncture depth is controlled and does not exceed 2.4 mm in depth. The capillary bed of the infant is 0.35 to 1.6 mm beneath the skin surface. A puncture of the plantar surface of the heel to a depth of 2.4 mm punctures the major capillary beds and does not injure the bone or nerves of the heel. Numerous devices are available commercially that meet the requirement of a puncture of 2.4 mm deep or less.

Avoid puncture of the infant's fingers. The distance to the bones and main nerves of the infant's fingers is 1.2 to 2.2 mm. Most lancets are longer than this and puncture of the infant's finger could result in damage to bone or nerves with subsequent infection or permanent physical damage. The infant's finger also does not produce an adequate blood specimen.

Precautions When Selecting a Puncture Site on the Heel

The puncture should not be done in a previous puncture site because of the possibility of infection. Do not do punctures in the central arch area of the foot. Puncture in this area may result in damage to nerves, tendons, and cartilage and offers no advantage over a heel puncture.

1. **Do not** puncture deeper than 2.4 mm.
2. **Do not** puncture through previous puncture sites.
3. **Do not** puncture the area between the imaginary boundaries.
4. **Do not** puncture the posterior curvature of the heel.
5. **Do not** puncture in the area of the arch.
6. **Do not** puncture areas of the foot other than the heel.

Precautions Collecting the Blood Sample

Several precautions must be observed to produce the most accurate specimen. Hemolysis is the greatest concern with microcollection samples. Hemolysis may occur because of the following situations:

1. The alcohol used to clean the skin was not allowed to dry.
2. The heel was squeezed too hard to produce a greater blood flow.
3. Newborn infants have increased red blood cell fragility and a high red blood cell volume. These factors result in a higher amount of hemolysis.
4. Instead of allowing the blood to flow into the microcollection container, the blood was scraped off the skin surface.
5. Collect samples for hematology first (purple micro-container).

Additional Precautions to Protect Well-Being of Infant:

1. The baby's heel may be punctured a maximum of two times. Do not stick a baby more than twice to obtain a specimen at any given time.
2. Do not puncture a foot if there are bruises, abrasions, or sloughing skin present. Notify the baby's nurse.
3. To help obtain a free-flowing puncture wound from a baby who doesn't bleed freely, wrap the baby's heel in a warm towel for 10 to 15 minutes before puncture is made. This is mandatory for collection of blood gases.
4. Never repuncture old puncture wounds.
5. **Never** remove a baby from its bassinet or change its position in any way without the approval of a nurse.
6. Use only gentle massage when obtaining blood. It is sufficient to massage with your thumb and forefinger or gentle squeezing.

Equipment needed for heelstick.

1. Gloves and gown
2. Disposable sterile lancets or automatic puncture devices
3. Collection containers, as required by test(s)
 - a. Capillary tubes and clay sealer
 - b. Diluting fluids
 - c. Calibrated pipettes
 - d. Microcollection containers
 - e. Glass sides
 - f. Filter paper form for neonatal screen
4. alcohol swabs
5. cotton balls
6. sterile gauze pads
7. capillary tube sealer
8. glass microscope slides
9. lab request slips or labels
10. Sharpee marking pen
11. Sharps container
12. Heel warming device, if applicable

Site warming procedures.

In order to collect an adequate amount of specimen from the heel puncture it is **critical** that the site be warmed prior to puncture. Blood flow can be increased up to seven times by warming the site prior to skin puncture. Warming can be accomplished by wrapping the site for a minimum of 3 minutes with a towel or diaper that has been moistened with comfortably warm water. Commercial heel warmers (both chemical and electrical) are also available.

Site cleaning procedure.

Skin puncture sites should be cleaned with 70% isopropanol. Do not use povidone iodine to clean skin puncture sites. Povidone iodine should not be used because it greatly interferes with a number of tests, most notably bilirubin, potassium, phosphorus, and uric acid.

Once cleansed, the site must be wiped dry with sterile gauze to eliminate alcohol residue. Alcohol residue, in addition to causing a stinging sensation, causes rapid hemolysis (rupture) of red blood cells. Alcohol residue has also been shown to interfere with glucose testing.

General procedure

Grasp the heel firmly but gently with the index finger wrapped around the foot supporting the arch, and the thumb wrapped around the ankle and below the puncture site. Perform the puncture perpendicular to the lines of the footprint, using a recommended heel puncture device.

Dispose of the puncture device promptly in a sharps container. Apply firm pressure toward the site. Wipe away the first drop of blood with a dry gauze. The first drop is usually contaminated with tissue fluid, and may cause

dilution of the specimen. This also gets rid of any remaining alcohol residue, which could hemolyze the specimen, as well as keep the blood from forming a well-rounded drop.

Position the site downward. Ask permission of the nurse prior to the puncture to elevate the babies bassinet so the head is higher than the feet. If baby is an outpatient have the mother hold the infant so the feet are lower. Gravity will greatly increase the flow of blood to the site. Do **not** squeeze or massage the site vigorously. Such activities introduce excess tissue fluid into the specimen and may also cause hemolysis of the specimen.

Proceed to collect the blood using devices appropriate for the type of test to be performed. Touch the collection device to the drop of blood formed on the surface of the skin. Capillary pipettes will fill by capillary action. When full, seal the ends of the capillary pipettes with clay.

Have this procedure demonstrated to you prior to performing. Improper position while holding and excess pressure when filling with clay can cause the tube to break and result in a puncture with a resultant blood exposure .

Microcollection tubes have a scoop which is touched to the drop of blood and the blood is allowed to run down the walls of the tube. Tap the tube gently now and then to encourage the blood to settle to the bottom of the tube and mix with the additive, if present. Do **not** use a scooping motion against the surface of the skin. Scraping the scoop against the skin activates platelets, which will cause the puncture site to stop bleeding, and may also cause hemolysis. Tapping the microtainer gently on a firm surface after collecting each drop allows the blood to move to the bottom and mix with the additive, if present. Remove the scoop and cap microcollection tubes with the caps provided and mix additive tubes 8 to 10 times.

When finished, apply pressure to the site with a clean gauze until bleeding stops. Keep the site elevated. Do **not** put a bandaid on the site. Adhesive bandages may irritate the skin and may even tear the skin of newborns, especially premature infants, when removed. Tie a gauze over the site. Label the containers at the bedside with the appropriate information. Before leaving the baby recheck the site to make sure bleeding has stopped. If it has not, contact the nurse immediately.

Transporting the specimen.

Specimens should be submitted as soon as possible to the lab after blood collection. Babies are being discharged more quickly now. If the specimen is found to be unacceptable this will allow a recollect prior to the baby being sent home.

If a *bilirubin* level is ordered on the infant it is **critical to protect the specimen from light**. Bilirubin is a by product of red blood cell metabolism. Bilirubin is broken down further in the liver into harmless components. Due their immature liver or other problems, babies may have an accumulation of dangerous bilirubin levels which can cause brain damage or death. Bilirubin is what causes the jaundiced appearance of newborns. Because it is light sensitive, phototherapy is the treatment of choice, because it breaks down the bilirubin and reduces it to normal levels. Light is good for treatment, but if a blood specimen is exposed to light it could cause a false decrease in the results obtained in the lab.

PROCEDURE

1. Ask directions to the appropriate nursery entrance.
2. Place blood collection tray on the table near the scrub sinks **outside** the nursery.
3. Look at requisitions and select **all** equipment needed into a container to take into the nursery with you. **Never** take the blood collection tray into the nursery.
4. Remove rings, watches, and lab coat.
5. Wash hands with soap provided in the manner and for the length of time specified by nursery personnel. If pedals are available, use them. If handles, use paper towel used to dry your hands to turn off faucet.
6. Put on a gown with ties in the back.
7. Put on gloves.
8. Carry supplies to the baby's bedside.
9. Identify the baby by making sure the request slip is identical to the baby's armband.
10. After ensuring the skin is warm, perform a heel puncture to with a lancet appropriate for an infant to obtain the proper blood specimen for the tests requested. Immediately dispose of the lancet into the sharps container.
11. Hold a clean cotton gauze over the puncture site until bleeding stops. **DO NOT** put adhesive strips on the baby's feet.
12. Remove all collection equipment from the bassinet to avoid harming the baby.
13. Immediately label all specimens with the appropriate information.
14. Before leaving the baby's bedside check the puncture wound again to ensure that bleeding has stopped. If it has not notify the nurse immediately.
15. Before collecting blood from the next baby, wash hands at the sink inside the nursery proper and change gloves.
16. Remove gown and gloves and discard in proper receptacle.
17. Wash hands.
18. Initial the log book and notate all tests collected. When moving from one nursery area to the other, the blood collector must repeat the complete procedure and put on a clean gown and gloves.

EXERCISE 3: HEELSTICKS - STUDY QUESTIONS

Name _____

Points: 16 points

1. State the composition of skin puncture blood and list tests that *cannot* be performed on skin puncture specimens. (2 points)
2. Describe, in detail, the proper site location on the heel for heel puncture blood collection. (1 point)
3. State the maximum depth of the puncture site and the reasons for not exceeding this depth. (1 point)
4. Describe how to properly warm the heel and why this is important. (1 point)
5. Describe the general appearance of an appropriate collection site for heel puncture and areas which should be avoided (2 points).

6. List 6 precautions involved in *selecting a site* for the heel puncture. (3 points)
- 1.
 - 2.
 - 3.
 - 4.
 - 5.
 - 6.
7. List 4 precautions for *collection of the blood* from a heel puncture. (2 points)
- 1.
 - 2.
 - 3.
 - 4.
7. List 4 precautions for protecting the general well-being of the infant. (2 points)
- 1.
 - 2.
 - 3.
 - 4.
8. State why it is important to protect microspecimens from light. (1 point)
9. THINKING QUESTION: Why are samples for hematology collected first. (1 point)