

EXERCISE 4: MICROCOLLECTION AND HEMATOCRITS

Hematocrit Skills: 10 points

Capillary Puncture Skills: 25 points

Objectives:

1. List and describe three types of patients who may be candidates for capillary puncture and state what would make them a candidate.
2. Identify two potential sites for capillary puncture.
3. List three areas to avoid for microcollection and the reason for each.
4. List and select the types of equipment needed to collect blood by microcollection.
5. List and describe two advantages for using an automated skin puncture device (lancet).
6. State the significance of a red ring and blue ring on microhematocrit tubes.
7. State the reason for warming the site for performing a skin puncture site.
8. Describe four acceptable methods for warming the skin puncture site.
9. List the steps necessary to perform a capillary puncture in chronological order.
10. List five circumstances that would lead to **recollection or rejection** of a microcollection sample.
11. List ten special precautions necessary **during** microcollection.
12. State the order of the draw for samples collected by microcollection.
13. State the purpose for performing the microhematocrit test.
14. Given a diagram of a spun microhematocrit tube label the three layers.
15. Describe the correct procedure and precautions for filling and sealing the microhematocrit tube.
16. List the order of the draw for capillary samples.
17. Demonstrate concern for the safety and welfare of yourself and others by consistently using appropriate infection control techniques.
18. Demonstrate appropriate concern for your classmate by explaining the procedure.
19. Perform a competent and effective microcollection of capillary blood from the fingertip with no contamination from tissue fluid and with minimum trauma.
20. Correctly perform and interpret the microhematocrit test with 90% accuracy.
21. State the normal values for a hematocrit.

Discussion

Skin Puncture Site

There are many terms used for "microcollection" and they include: capillary puncture, dermal puncture, microsampling, finger puncture and heel puncture. Microcollection is a blood collection technique using the finger or heel. The distal portion of the second, third or fourth finger can be used but the middle finger is usually the site of choice. Refer to Lab 3 for site selection for heels.

Avoid sites that are cyanotic (blue), swollen or inflamed. If the area is blue it indicates decreased blood flow to the site, usually because the area is cold. Either warm the site or select a site that is warm. Swollen or edematous areas should not be used because of possible contamination of the sample with tissue fluids which can contaminate the specimen. Inflamed or red areas may be an indication of an infection.

Patients Who are Candidates for Microcollection

Microcollection techniques may be the procedure of choice for the following patients:

1. **Neonates** - Newborns do not have a very large blood volume and it is very dangerous to remove too large a volume of blood, which would occur with a venipuncture. A 10 mL sample from a premature or newborn infant can represent 5 to 10 percent of the total blood volume in the entire body. The blood is obtained from the sides of the heel. **The bottoms and backs of the heels are NEVER used for microcollection due to the possibility of causing damage to the bone or nerves with subsequent infection or permanent physical damage.** Infant's fingers should never be punctured due to the short distance to the bones and main nerves of the infant's fingers. Refer to Exercise 3 for details of this procedure.
2. **Pediatric patients** - if only a small amount of blood is needed, the tip of the third or fourth finger is generally punctured. An example would be if only a CBC is ordered on a child. This test can be performed on a small amount of blood. This is a less traumatic procedure than a venipuncture for a young child.
3. **Adults** - microcollection may be the procedure of choice in the **following adult patients**: severely burned, obese, patients with thrombotic tendencies, oncology patients to save their veins for future chemotherapy, geriatric patients, patients with fragile or **very** poor veins, patients with I.V.s in both arms, and patients doing home testing such as glucose monitoring.

Microcollection Equipment

The types of equipment necessary for microcollection varies in how it is used but always makes either a puncture or cut into the skin and through the capillary bed. The equipment used to collect the blood depends on the type of patient and the particular test being performed.

The types of supplies available for skin puncture vary but may include the following: gloves, lancets or automatic puncture devices, capillary tubes or micropipettes, disinfectant pads, bandages or gauze pads, glass microscope slides, microcollection tubes or capillary tubes, capillary tube clay sealer, warming pads, laboratory request slips or labels, a marking pen and a sharps container.

When collecting blood into microcollection containers the order of the draw is: lavender, other additives (green, gray) and tubes without additives (red or yellow).

Skin Puncture Devices

Lancets have a sharp metal point or blade and are designed for a controlled depth of puncture ranging from 1.8 to 3.0 mm. Babies should **never** be stuck with a puncture device that exceeds 2.0 mm. Lancets for capillary puncture are safety-engineered, single-use capillary blood sampling devices. The lancets currently used have a permanently retractable blade or needle feature that minimizes the possibility of injury or reuse. Lancets are available in a range of blade depth and needle gauges for sufficient blood volume in multiple sample requirements. Lancets are disposable and can **be used only one time**. If an unsuccessful puncture is performed, a new lancet must be used.

All lancets for microcollection are automated puncture devices. The advantage of using these devices is that they are spring loaded and are designed to give a quick, more uniform puncture of a specified depth. Another advantage is that the device hides the blade in a plastic holder so the patient cannot see it. This prevents apprehensive patients, especially children, from pulling their hand away just as the phlebotomist is ready to perform the puncture and prevent the phlebotomist from possibly puncturing themselves. These skin puncture devices are available for punctures of different depths.

Devices on the market for diabetic at home glucose monitoring **should not** be used for microcollection. These devices provide a blood flow of one to two drops, adequate for the glucose test, but this is not adequate blood flow for the sample size needed for most laboratory tests.

Tubes Used For Sample Collection

Micropipettes, microtainers microhematocrit tubes and capillary tubes for collecting skin puncture blood are manufactured in a variety of bore sizes, volume capacities and shapes. Microhematocrit tubes may be coated with heparin and will have a red ring at the top or may not be coated (plain) and have a blue ring at the top. Other collection devices may be conical, cylindrical, straight-walled with open ends and may be made from glass or plastic. There should be a means for proper filling, measuring, color coding for the proper anticoagulant, stoppering, centrifugation and storage.

Warming the Site

In order to ensure an adequate blood flow following a successful capillary puncture the site should feel warm to the touch. Cool skin indicates decreased blood flow to the area and the potential that, even though the puncture is performed properly, an adequate amount of blood will not be obtained. There are several methods available for warming the site and include the following:

1. Have the patients run warm tap water over their hands for two to three minutes.
2. Gently massage the area for 1 to 2 minutes.
3. Obtain a wash cloth, wet it with warm water and wrap it around the site. When wrapped around the site for 3 to 10 minutes the skin temperature can increase several degrees. The wrap can be encased in a plastic bag to help retain heat and keep the patient's bed dry. If a blood collection is ordered on another patient, the phlebotomist can perform that draw then return and perform the capillary puncture.
4. Heel warmers are available commercially for use on neonates. It is a chemically activated source of heat. It prevents the possibility of burning the baby's skin with a too warm wash cloth.

Labeling the Samples

Samples must be labeled at the bedside. Computer generated adhesive labels can be wrapped around the sample. If these are not available put as much identifying information as possible on the micro-container then place the micro container into a red stoppered vacuum collection tube. Label the tube in the proper manner.

Precautions in Microcollection Techniques

1. Puncture laterally across the print. If the puncture is performed along the print the blood will flow with the print making it very difficult to collect, causing unnecessary contamination of your gloves and work area with blood.
2. The first drop of blood must be wiped off to prevent contamination of the specimen with tissue fluids. Tissue fluids contain coagulation factors that can accelerate coagulation (clumping of the blood) making it unacceptable for testing.
3. Collect hematology specimens *first*. When collecting blood for hematology tests the finger must be wiped dry after each test drawn. Platelets will begin to clump immediately in the blood at the puncture site. The values for the red blood cell count, hematocrit, hemoglobin and platelets are lower in capillary blood than in venous blood. Therefore, whenever possible and the patient is old enough, venipuncture should be performed.
4. Because of platelet adhesiveness and aggregation (clumping) at the site of the puncture it is advisable to collect the platelet count and blood smear first if multiple tests are ordered.
5. When filling the collection tubes the blood must be mixed well after the addition of each drop if the tube contains an additive. Samples that are not well mixed will clot and will have to be recollected.
6. Capillary tubes with a blue ring do not have an anticoagulant and do not need to be mixed. Capillary tubes with a red ring contain the anticoagulant heparin, which prevents blood from clotting. The red ringed tubes must be inverted several times to allow the blood to mix with the heparin. If the blood does clot the specimen will have to be recollected.
7. Do not overfill the capillary tube. If the tube is completely full blood will leak out when the end is filled with clay. This will unnecessarily contaminate your gloves or work area with blood.
8. Be **very** careful when filling the end of the capillary tube with clay. If the tube is held in the middle or far from the end being filled with clay it may break when pressure is applied. The broken end will pierce the skin and allow a large inoculum of blood into your bloodstream. This is more dangerous than a needle stick injury due to the amount of blood present in the capillary tube. If this type of injury occurs notify your instructor or, if you are at the clinical site, clinical instructor **IMMEDIATELY**.
9. If you have attempted the procedure twice and are not successful do not puncture the person a third time, except in very unusual circumstances.
10. Always check the puncture site before leaving to make sure bleeding has stopped.
11. Never put an adhesive Band-ad on the puncture site of an infant or very small child.

Rejection of Microcollection Samples

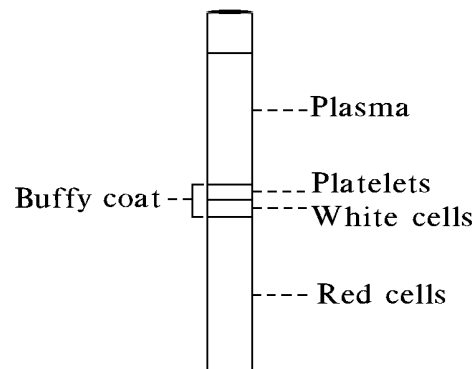
The following may cause a sample to be unacceptable for laboratory testing. **If this occurs the sample must be recollected.**

1. If the first drop of blood is not wiped away sample will be contaminated with tissue fluid.
2. Excessive squeezing of the capillary puncture site to obtain the specimen will contaminate the specimen with excess tissue fluid.
3. Microcollection tubes with additives must be mixed frequently during collection to prevent the specimen from clotting.
4. Alcohol must be completely dry prior to puncture as alcohol will cause hemolysis of the blood sample.
5. Certain tests **must** be free of air bubbles, which will cause falsely decreased results in the test.
6. Wrong tube collected.
7. Improperly labeled sample.
8. Additive tubes which have clots.

Microhematocrit

The microhematocrit test is done to determine if a patient is anemic. It is quick and easy to perform, requires minimal equipment and is an excellent way to **screen** for anemia. After a skin puncture is performed the blood is collected in microhematocrit tubes and one end is sealed with clay. Then it is put in a special centrifuge (microhematocrit centrifuge) which spins the tubes around at a great rate of speed.

This causes the blood to separate into three layers: plasma, buffy coat (which contains platelets and white blood cells), and red blood cells.



After spinning, the tube is placed on a special type of card or other device to determine the reading. The hematocrit is expressed as a per cent and determines what per cent of the whole blood is plasma and what per cent are red blood cells.

Reading of the Microhematocrit

Microhematocrit reader device:

1. Set the reader first with the clay-red cell interface at 0%.
2. Shift the ruled scale or etched line to 100% and align it with the plasma meniscus.
3. Read down to the percent spiral line that intersects with the RBC-WBC interface.
4. This percentage is the hematocrit value. .

Microhematocrit reader card:

1. Place the centrifuged microhematocrit tube vertically on the chart with the bottom edge of the CRITOSEAL just touching the red line below the A0" percent line.
2. The bottom of the column of the blood should then be at the A0" percent line.
3. Slide the tube along the chart until the meniscus of the plasma intersects the A100" percent line.
4. The height of the packed red cell column is then read as a percent

Precautions When Reading Results

1. The results of the two hematocrits should agree within 1 %.
2. Do NOT include the buffy coat layer when reading the results.
3. If the buffy coat layer exceeds 2%, it should be recorded and noted as volume of packed WBCs.

Normal Values

The normal values for people differ, women and children have lower values than men and newborn babies. The following chart lists the normal values:

Newborn	45 - 50%
One year	27 - 44%
Women	36 - 48%
Men	40 - 55%

Lower than normal results are due to a wide variety of causes including: poor diet, chemotherapy, drug therapy, gastrointestinal bleeding, or bleeding due to surgery or trauma.

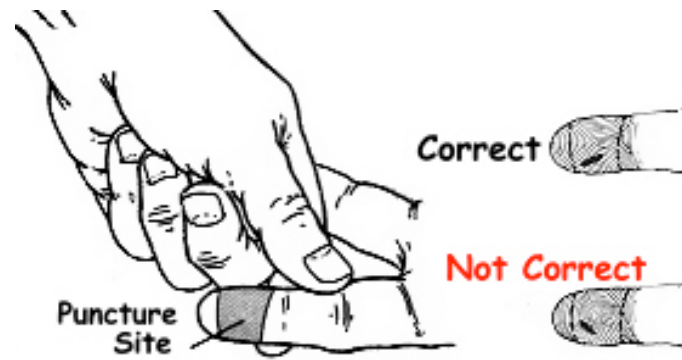
PROCEDURE

Materials:

1. Lancet
2. Alcohol Pad
3. Biowipe
4. Two microhematocrit tubes or microcollection devices
5. Clay tube sealer
6. Gloves
7. Band-Aid

Instructions:

1. Assemble all equipment.
2. Introduce yourself and state your mission.
3. Properly greet and identify the patient.
4. Explain procedure if necessary
5. Select an appropriate site on the third or fourth finger of the hand.
6. The puncture site chosen should feel warm, if the site is cool warm by gently massaging the finger, have the patient run warm water over the site or wrap in a warm cloth for several minutes.
7. Rub the puncture site **vigorously** with an alcohol swab to cleanse the area and increase the circulation.
8. Allow the skin to dry. *Dry skin allows the blood to form a well rounded drop something it will not do on moist skin.* Alcohol left on the site will contaminate the blood sample collected and cause hemolysis of the sample. **Cotton balls should not be used** to wipe the site as small pieces of cotton may stick to the finger and interfere with the collection of blood.
9. Prepare the lancet according to manufacturer=s instructions.
10. The patient's hand and finger should be held **laterally** so that the puncture site is readily accessible. The skin near the chosen sites should be pulled taut. Hold the lancet **firmly** against the skin, on the little finger side, and activate it according to manufacturer=s instructions. **NOTE:** Failure to hold the lancet firmly against the skin may result in a shallow puncture which fails to bleed or does not provide an adequate amount of blood making it necessary to **repeat** the procedure.
11. Squeeze the finger **firmly** to initiate the blood flow and **WIPE AWAY THE FIRST DROP OF BLOOD** with a Biowipe. The first drop contains tissue fluid which will contaminate the blood sample collected.
12. Apply firm pressure, approximately 1 cm behind the site of the puncture, to obtain a drop of blood. Immediately release the pressure to allow recirculation of the blood. If the finger is squeezed continuously without release the finger will force tissue fluid into the sample, causing contamination of the sample. The squeeze/release technique must be used to obtain an acceptable sample. It may be necessary to massage the finger to increase blood flow. Pressure should not be applied near the puncture site.



13. This technique will cause the formation of a well rounded drop of blood. Carefully touch the tip of the microhematocrit tube to the drop of blood. **DO NOT ALLOW THE COLLECTION DEVICE TO TOUCH THE PUNCTURE SITE.** The tube should be held at a downward angle. Blood will flow by capillary action into the tube. **Avoid air bubbles.**
14. The tube should be filled 2/3 to 3/4 full. **DO NOT OVERFILL.** Heparinized (red ring) should always be used when collecting capillary samples. The sample should be collected quickly and the tube carefully inverted to mix the blood with the heparin to prevent clotting.
15. After collecting the two microhematocrit tubes fill ONE end of each tube with clay. Hold the clay perpendicular to the counter. Grasp the microhematocrit tube as close to the end that will be filled with clay as possible. Gently push the end into the clay 2 to 3 times. **Use great care, too much pressure will cause tube to break and puncture your skin, causing a blood exposure.** CAUTION: Only the microhematocrit test requires the end of the tube to be filled with clay. For all other tests do not fill end with clay.
16. After collecting the specimen apply a biowipe or gauze pad to the puncture site, using slight pressure until the bleeding has stopped. **DO NOT** use the alcohol pad.
17. Dispose of the lancet in the sharps container and all other materials in regular trash.
18. Check puncture site and apply band aid if necessary.
19. Thank patient.
20. Give the two microhematocrit tubes to the instructor for verification that the procedure was performed correctly. The instructor will spin the tubes down and aid you in reading the results.
21. Remove gloves and wash hands.

EXERCISE 4: MICROCOLLECTION

RECORDING RESULTS

Name _____ Date _____

Hematocrit Results	Tube 1	Tube 2	Results (use correct units)
Patient Name:			

Are these results within the normal range (circle one)? **YES** **NO**

EXERCISE 4: MICROCOLLECTION - STUDY QUESTIONS

Name _____

Date _____

Points: 38

1. List three types of patients who may be candidates for capillary puncture **AND** the reason they would be candidates for this procedure. (3 points).
 - A.
 - B.
 - C.
2. List three areas to avoid for microcollection and the reason for each. (3 points)
 - A.
 - B.
 - C.
3. List the 2 most commonly used sites for capillary puncture (1 point).
 - A.
 - B.
4. Explain why capillary puncture should not be performed on an infant's finger (1 point).
5. List and describe two advantages for using an automated skin puncture device (lancet) (2 points).
 - A.
 - B.
6. Why is important that the site selected for capillary puncture be warm? (1 point)
7. List and describe four methods for warming the site prior to puncture (2 points).
 - A.
 - B.
 - C.
 - D.

8. What is the purpose for performing the microhematocrit test? (1 point)
9. Give the values for normal hematocrits using the proper units for the following patients (2 points):

<i>Patient</i>	<i>Normal Values</i>
Newborn	
One year old	
Women	
Men	

10. State why the site must NOT be punctured in such a way that the puncture is made along the lines of the print instead of laterally across the print (1 point).
11. State why the first drop of blood produced **must** be wiped away (1 points).
12. Discuss why the alcohol on the site must be completely dry prior to puncture (1 point).
13. What additive is in the capillary tubes with a blue ring? a red ring? (1 point)
14. Why must collection tubes with additives be well mixed during sample collection? (1 point)
15. State why great care must be taken when filling the end of the microhematocrit tube with clay (1 point).
16. State why it is important not to overfill the capillary tube (1 point).
17. Briefly list four precautions in microcollection techniques (4 points).

A.

B.

C.

D.

18. What is the maximum number of attempts which should be made using the capillary puncture technique (1 point).

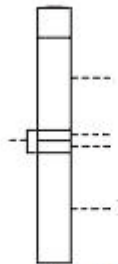
19. State three circumstances that would lead to rejection of a patient microcollection sample (3 points).

A.

B.

C.

20. Label the following diagram of a spun microhematocrit tube (2 points).



Cell layers in centrifuged whole blood.

21. List the equipment used for a capillary puncture (2 points).

22. **Briefly** list in chronological order the steps for performing a capillary puncture (3 points). **THIS SHOULD BE A SUMMARY OF THE PROCEDURE NOT THE ENTIRE PROCEDURE.**