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PROCEDURE OF VENEPUNCTURE FOR BLOOD DONATION AND ARTERIAL BLOOD SAMPLING

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ABSTRACT: Blood banks use various processes to prevent infections that can be transmitted by blood donation. One important measure to prevent infection is to recruit donors from populations that are known to have low rates of infection for blood borne diseases, such as voluntary, unpaid donors and people with no history of intravenous drug use. A second measure is to ask donors a series of additional screening questions (these will vary by region) to help identify those who may be at higher risk of infection. Phlebotomists must adhere strictly to the rules for including and excluding blood donors. The process for collecting blood from donors is similar to that used for blood sampling; however, a few additional measures are required for collection of donated blood. These measures are primarily to ensure patient safety, but also to minimize exogenous contamination of a donated blood unit or its derived components, particularly contamination from the skin flora of the donor's arm.

Key words: Blood banks, blood borne diseases, phlebotomists

INTRODUCTION

Blood banks use various processes to prevent infections that can be transmitted by blood donation. One important measure to prevent infection is to recruit donors from populations that are known to have low rates of infection for blood borne diseases, such as voluntary, unpaid donors and people with no history of intravenous drug use. A second measure is to ask donors a series of additional screening questions (these will vary by region) to help identify those who may be at higher risk of infection. Phlebotomists must adhere strictly to the rules for including and excluding blood donors. A third measure is to test donated blood for infections common in the area before processing it for use for various therapeutic purposes.

The process for collecting blood from donors is similar to that used for blood sampling; however, a few additional measures are required for collection of donated blood. These measures are primarily to ensure patient safety, but also to minimize exogenous contamination of a donated blood unit or its derived components, particularly contamination from the skin flora of the donor's arm. Because of the volume or blood collected and the length of storage, pathogens can

multiply during storage. Safe collection ensures that the blood products are safe for therapeutic use throughout their shelf life. Skin flora is a common source of contaminants; it is therefore important to use an effective antiseptic on the donor's arm before blood donation.

Transfusion with blood components that are contaminated with exogenous bacteria or other agents can cause fatal complications (*1,2*). Studies on the topic have been inconclusive (*3*); however, based on available literature and expert opinion, the recommended option for skin antisepsis for blood donation is the one step application of a combination of 2% chlorhexidine gluconate and 70% isopropyl alcohol for 30 seconds, followed by 30 seconds drying time (*4,5,6*).

Before a blood donation (7):

- The potential donor should be given pre-donation information, advice and counseling about the process of blood donation
- A relevant history of the donor should be taken, covering health and high-risk behavior and including history of mastectomy (blood should be taken from the arm opposite the site of surgery) (5)
- Current and recent medications or chronic infections
- History of prolonged bleeding or a past diagnosis of bleeding disorders
- History of previous donations to ensure the waiting period is respected
- A preliminary physical check-up of the donor should be done, including weight, blood pressure, signs of infection or scarring at potential sites
- The donor should be offered fluids, to help reduce the risk of fainting after blood donation (*8*)
- The person should provide informed written consent, based on the national requirements.

Practical guidance on venepuncture for blood donation

Collecting blood

For collection of blood for donation, Universal safety precautions has to be maintained.

Step1 – Identify donor and label blood collection bag and test tubes

• Ask the donor to state their full name.
• Ensure that:
— The blood collection bag is of the correct type
— The labels on the blood collection bag and all its satellite bags, sample tubes and donor records have the correct patient name and number
— The information on the labels matches with the donor's information

Step 2 – Select the vein

• Select a large, firm vein, preferably in the antecubital fossa, from an area free from skin lesions or scars
• Apply a tourniquet or blood pressure cuff inflated to 40–60 mm Hg, to make the vein more prominent
• Ask the donor to open and close the hand a few times.
• Once the vein is selected, release the pressure device or tourniquet before the skin site is prepared.

Step 3 – Disinfect the skin

• If the site selected for venepuncture is visibly dirty, wash the area with soap and water and then wipe it dry with single-use towels.
• *One-step procedure* (recommended – takes about one minute):
— use a product combining 2% chlorhexidine gluconate in 70% isopropyl alcohol;
— cover the whole area and ensure that the skin area is in contact with the disinfectant for **at least** 30 seconds;
— allow the area to dry **completely**, or for a minimum of 30 seconds.
• *Two-step procedure* (if chlorhexidine gluconate in 70% isopropyl alcohol is not available, use the following procedure – takes about two minutes):
— *step 1* – use 70% isopropyl alcohol
— cover the whole area and ensure that the skin area is in contact with the disinfectant for **at least** 30 seconds.

— allow the area to dry **completely** (about 30 seconds)
— *step 2* – use tincture of iodine (more effective than povidine iodine) or chlorhexidine (2%)
— cover the whole area and ensure that the skin area is in contact with the disinfectant for **at least** 30 seconds
— allow the area to dry **completely** (about 30 seconds)
• Whichever procedure is used, DO NOT touch the venepuncture site once the skin has been disinfected.

Step 4 – Perform the venepuncture

Tighten the tourniquet so that vein becomes prominent. Perform venepuncture using a smooth, clean entry with the needle.
Take into account the points given below, which are specific to blood donation.
• In general, use a 16-gauge needle which is usually attached to the blood collection bag. Use of a retractable needle or safety needle with a needle cover is preferred if available, but all should be cut off at the end of the procedure rather than recapped.
• Ask the donor to open and close the fist slowly every 10–12 seconds during collection.
• Remove the tourniquet when the blood flow is established or after 2 minutes, whichever comes first.

Step 5 – Monitor the donor and the donated unit

• Closely monitor the donor and the injection site throughout the donation process – look for:
— Sweating, pallor or complaints of feeling faint that may precede fainting
— Development of a haematoma at the injection site
— Changes in blood flow that may indicate the needle has moved in the vein and needs to be repositioned.
• About every 30 seconds during the donation, mix the collected blood gently with the anticoagulant, either manually or by continuous mechanical mixing.

Step 6 – Remove the needle and collect samples
• Cut off the needle using a sterile pair of scissors.
• Collect blood samples for laboratory testing.

After a blood donation

Donor care
After the blood has been collected:
• Ask the donor to remain in the chair and relax for a few minutes
• Inspect the venepuncture site; if it is not bleeding, apply a bandage to the site; if it is bleeding, apply pressure bandage
• Ask the donor to sit up slowly and ask how the person is feeling
• Before the donor leaves the donation room, ensure that the person can stand up without dizziness and without a drop in blood pressure
• Offer the donor some refreshments

Blood unit and samples
• Transfer the blood unit to a proper storage container according to the blood centre requirements and the product
• Ensure that collected blood samples are stored and delivered to the laboratory with completed documentation, at the recommended temperature and in a leak-proof, closed container (*9,10,11*).

Adverse events in blood donation (12,13,14)

Adverse event	Causes	Management
Haematoma	• Poor or failed venepuncture • Skin pierced at too great an angle • Needle puncturing the vein twice during the donation • Inadequate pressure after the donation	• Apply pressure and a firm bandage • Advise donor to move arm freely but to avoid heavy lifting • Apologize and reassure the donor
Vasovagal reaction or faint, due to a hypothalamic response resulting in bradycardia, vomiting, sweating, arterial dilatation and a low blood pressure	• Anxiety • Lowered blood volume and other associated causes: —hypoglycemia —lack of fluids — poor sleep • Atmosphere in donation room (hot or humid) *Signs and symptoms* • Staring • Pallor or sweating • Slow pulse • Drop in blood pressure • Vomiting • Loss of consciousness (occasionally) • Convulsions (rare)	*Mild vasovagal reaction* • Discontinue donation • Recline chair • Loosen clothes • Monitor blood pressure and pulse • Reassure donor • Give fluids to the donor to drink (recovery is usually rapid) *Severe vasovagal reaction* • Call physician • If the donor becomes unconscious, put the person in recovery position (i.e. head to the side and chin up) and ensure that airways are clear *Faints* • These are usually self limiting and do not require investigation because they have no underlying pathology
Delayed faint (syncope)	• Physical stress • Inadequate fluid intake • Cause unknown Occurs 1–4 hours after donation, usually outside the blood bank	Hot drinks or water before donating blood; sitting in a supine position, audio or visual distraction; and minimal pain and stress during blood donation
Arterial puncture	• Brachial artery sometimes lies anatomically very close to the vein • Detected by observing that the blood collected is bright red and has a rapid flow • May result in late complications such as arteriovenous fistulae	• Discontinue donation or continue if identified towards the completion of the donation • Call the donor care physician • Apply firm pressure (by the nurse or medical staff), for at least 15 minutes • Apply pressure bandage and check the radial pulse • Inform and reassure donor and explain that the puncture is unlikely to have serious consequences, but that bad bruising may occur, and healing takes about 10–14 days
Nerve damage	• Nerve endings brushed during venepuncture • Pressure from haematoma *Symptoms and signs* • Pain or parasthesia • Motor or sensory loss	• Refer the donor to the physician to explain and reassure the donor and refer the donor to a neurologist if the damage is severe

Procedure of arterial blood collection:

An arterial blood sample is collected from an artery, primarily to determine arterial blood gases. Arterial blood sampling should only be performed by health workers for whom the procedure is in the legal scope of practice for their position in their country and who have demonstrated proficiency after formal training. The sample can be obtained either through a catheter placed in an artery or by using a needle and syringe to puncture an artery. These syringes are pre-heparinized and handled to minimize air exposure that will alter the blood gas values.

Several different arteries can be used for blood collection. The main sites are

- Radial artery
- Brachial artery
- Femoral artery
- Dorsalis pedis artery

The first choice is the radial artery, which is located on the thumb side of the wrist. It is preferred site because,

- It is near the surface and relatively easy to palpate and stabilize
- Effective collateral circulation exists in the ulnar artery
- The artery doesn't have any large veins by the sides
- The procedure is relatively pain free

Alternative sites for access are brachial or femoral arteries, but these have several disadvantages in that they:

• May be harder to locate, because they are less superficial than the radial artery.
• Have poor collateral circulation.
• Are surrounded by structures that could be damaged by faulty technique.

In infants arterial puncture is done in,

1. Radial artery
2. Temporal artery

Equipments required:

- Standard precautions barrier protection like gloves, safety goggles etc
- Pre-heparinized syringe
- Needles (20, 23 and 25 gauge, of different lengths) – choose a size that is appropriate for the site (smaller gauges are more likely to lyse the specimen)
- A safety syringe with a needle cover that allows the syringe to be capped before transport, without manually recapping (this is best practice for radial blood sampling)
- A bandage to cover the puncture site after collection;
- A container with crushed ice for transportation of the sample to the laboratory (if the analysis is not done at the point of care)
- Local anesthetic and an additional single-use sterile syringe and needle

Before performing a radial artery puncture, modified allen's test has to be performed to look for collateral circulation in hand

Modified Allen test:

1. A modified Allen test measures arterial competency and should be performed before taking an arterial sample. The procedure for performing the test is as follows.
2. Instruct the patient to clench his or her fist; if the patient is unable to do this, close the person's hand tightly.
3. Using your fingers, apply occlusive pressure to both the ulnar and radial arteries, to obstruct blood flow to the hand.
4. While applying occlusive pressure to both arteries, have the patient relax his or her hand and check whether the palm and fingers have blanched. If this is not the case, you have not completely occluded the arteries with your fingers.
5. Release the occlusive pressure on the ulnar artery only to determine whether the modified Allen test is positive or negative.

• *Positive modified Allen test* – If the hand flushes within 5–15 seconds it indicates that the ulnar artery has good blood flow; this normal flushing of the hand is considered to be a positive test.

• *Negative modified Allen test* – If the hand does not flush within 5–15 seconds, it indicates that ulnar circulation is inadequate or nonexistent; in this situation, the radial artery supplying arterial blood to that hand should not be punctured.

Following are the situations in which allen's test cant be performed

- Unconscious patient
- Uncooperative patient
- Prior radial artery cannulation
- Sever circulatory insufficiency
- Wrist or hand burns
- When patient has Jaundice

Note: In such cases a Doppler pulse transducer should be used to asses the pulsatile flow of the thumb with or without ulnar occlusion. If the quick release of pressure restores a good pulse, collateral floe is present and the radial artery puncture can be performed.

Procedure for arterial blood sampling using radial artery

1. For sampling from the radial artery using a needle and syringe, follow the steps outlined below.
2. Approach the patient, introduce yourself and ask the patient to state their full name.
3. Place the patient on their back, lying flat. Ask the nurse for assistance if the patient's position needs to be altered to make them more comfortable. If the patient is clenching their fist, holding their breath or crying, this can change breathing and thus alter the test result.
4. Locate the radial artery after performing an Allen test for collateral circulation.
5. If the initial test fails to locate the radial artery, repeat the test on the other hand. Once a site is identified, note anatomic landmarks to be able to find the site again. If it will be necessary to palpate the site again, put on sterile gloves.
6. Perform hand hygiene, clear off a bedside work area and prepare supplies. Put on an impervious gown or apron, and face protection, if exposure to blood is anticipated.
7. Disinfect the sampling site on the patient with 70% alcohol and allow it to dry.
8. If the needle and syringe are not preassembled, assemble the needle and heparinized syringe and pull the syringe plunger to the required fill level recommended by the local laboratory.
9. Holding the syringe and needle like a dart, use the index finger to locate the pulse again, inform the patient that the skin is about to be pierced then insert the needle at a 45 degree angle, approximately 1 cm distal to (i.e. away from) the index finger, to avoid contaminating the area where the needle enters the skin.
10. Advance the needle into the radial artery until a blood flashback appears, then allow the syringe to fill to the appropriate level. DO NOT pull back the syringe plunger.
11. Withdraw the needle and syringe; place a clean, dry piece of gauze or cotton wool over the site and have the patient or an assistant apply firm pressure for sufficient time to stop the bleeding. Check whether bleeding has stopped after 2–3 minutes. Five minutes or more may be needed for patients who have high blood pressure or a bleeding disorder, or are taking anticoagulants.
12. Activate the mechanisms of a safety needle to cover the needle before placing it in the ice cup.
13. Expel air bubbles, cap the syringe and roll the specimen between the hands to gently mix it. Cap the syringe to prevent contact between the arterial blood sample and the air and to prevent leaking during transport to the laboratory.
14. Label the sample syringe.
15. Dispose appropriately of all used material and personal protective equipment.
16. Remove gloves and wash hands thoroughly with soap and water, then dry using single-use towels; alternatively, use alcohol rub solution.
17. Check the patient site for bleeding (if necessary, apply additional pressure) and thank the patient.
18. Transport the sample immediately to the laboratory following laboratory handling procedures.

Complications related to arterial blood sampling

There are several potential complications related to arterial blood sampling. The points below list some of the complications related to the procedure and how they can be prevented (*15*).

• ***Arteriospasm*** or involuntary contraction of the artery may be prevented simply by helping the patient relax; this can be achieved, for example, by explaining the procedure and positioning the person comfortably.

• ***Haematoma*** or excessive bleeding can be prevented by inserting the needle without puncturing the far side of the vessel and by applying pressure immediately after blood is drawn. Due to the higher pressure present in arteries, pressure should be applied for a longer time than when sampling from a vein, and should be supervised more closely, to check for cessation of bleeding.

• *Nerve damage* can be prevented by choosing an appropriate sampling site and avoiding redirection of the needle.

• ***Fainting* or a *vasovagal response*** can be prevented by ensuring that the patient is supine (lying down on their back) with feet elevated before beginning the blood draw. Patients requiring arterial blood sampling are usually inpatients or in the emergency ward, so will generally already be lying in a hospital bed. Children may feel a loss of control and fight more if placed in a supine position; in such cases, it may be preferable to have the child sitting on the parent's lap, so that the parent can gently restrain the child.

• *Other problems* can include a drop in blood pressure, complaints of feeling faint, sweating or pallor that may precede a loss of consciousness.

Sampling errors

Inappropriate collection and handling of arterial blood specimens can produce incorrect results.

Reasons for an inaccurate blood result include:

• Presence of air in the sample

• Collection of venous rather than arterial blood

• An improper quantity of heparin in the syringe, or improper mixing after blood is drawn

• A delay in specimen transportation.

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