"Blood Collection and handling"

The Blood:

Blood is a tissue circulates in a closed system of blood vessels. It consists of a cellular portion (red, white blood cells and the platelets), which forms (45%) of the blood volume and suspended in the cellular liquid medium plasma (55%) of blood volume.

Function of the Blood:

1. Respiration: Transport of oxygen from the lungs to the tissues and CO_2 from the tissues to the lungs.
2. Nutrition: Transport of absorbed food materials.
3. Excretion: Transport of metabolic wastes to the kidneys, lungs, skins, and intestines for removal.
4. Maintenance of normal acid-base balance in the body.
5. Regulation of water balance through the effect of blood on the exchange of water between the circulating fluid and the tissue fluid.
6. Regulation of the body temperature by the distribution of body heat.
7. Defense against infection by the white cells and the circulating antibodies.
8. Transport of hormones and metabolites.

The great majority of clinical chemistry analysis performed on blood and urine. These analyses required the whole blood, serum or plasma to be collected from patients.

Anticoagulants:

When the whole blood or plasma is required, an anticoagulant is required. The most commonly used are:

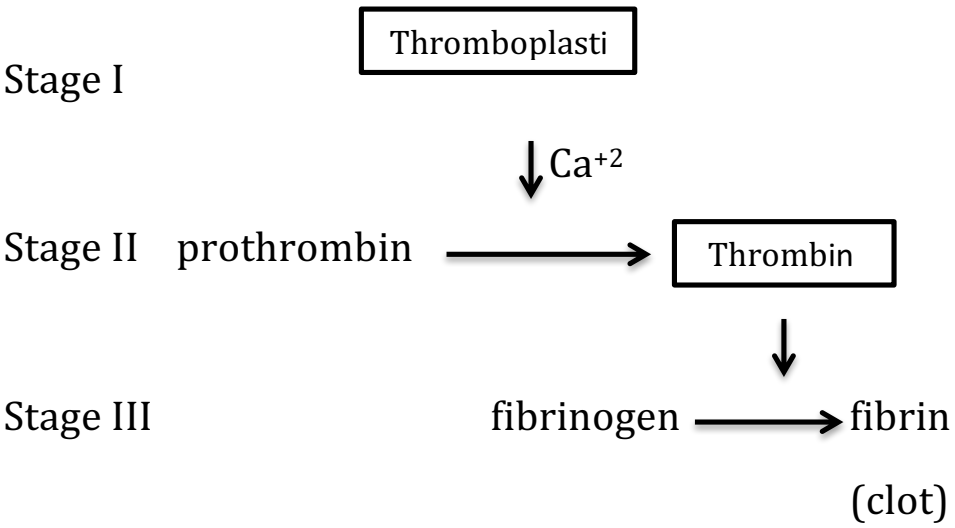
Heparin= is a normal blood constituent, but its physiological concentration is not high enough to prevent clotting in freshly down blood. it is a polysaccharide derivation and apparently function by inhibiting thrombin formation (anti-thrombin).

Oxalate= act by precipitating Ca^{+2} from the blood and prevents clotting. Potassium oxalate are used most commonly, also Li, Na and ammonium salts are used.
EDAT= acts similarly to oxalate, except that it chelates Ca^{+2} rather than precipitates it and therefore prevent clotting process.

The clotting processes

The blood clot is formed by a protein (fibrinogen) which is present in a soluble form in the plasma and which is transformed to an insoluble network or fibrous material (fibrin).

The change of fibrinogen to fibrin is caused by thrombin, which in blood fluid exists as prothrombin. The conversion of prothrombin to thrombin depends on the cation of thromboplastin and Ca^{+2}. These stages may be diagrammed as follows:



Biochemical specimens

Blood, urine, cerebra spinal fluid (CSF), gastric juice, synovial fluid, duodenum, amniotic fluid, as well as saliva, faces and other materials.

Blood types

There are three types of blood that can be used for testing:

Venous Blood, Arterial Blood, Capillary Blood

1- Venous Blood

1. It is free of complications.
2. Blood is taken from the superficial veins.
3. The commonest site is the antecubital fossa because of the presence of basilic vein, cephalic vein, median cubital veins are the commonest veins.
4. Veins of the wrist or hand may be used.
5. Another site is the femoral vein.

Blood venous is classified into:

1- Whole blood
2- Serum: whole blood + centrifuge
3- Plasma: whole blood +anticoagulant + centrifuge

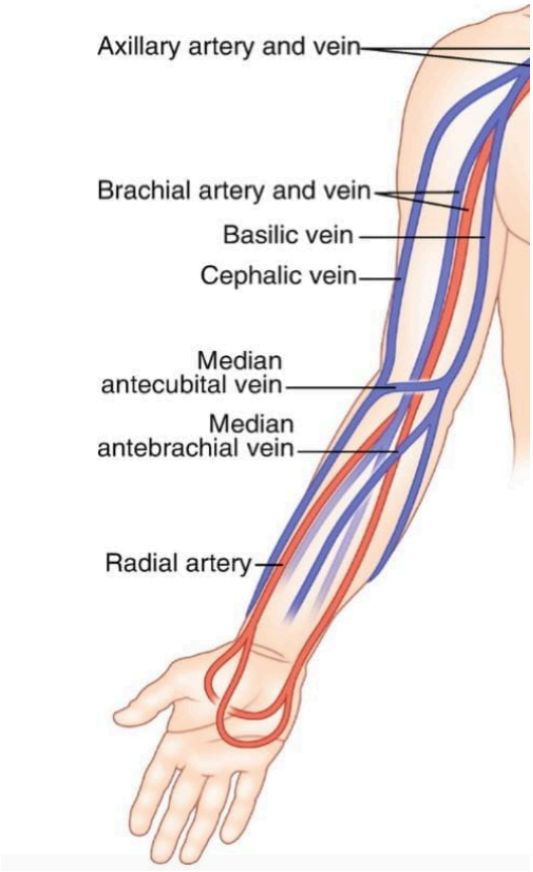
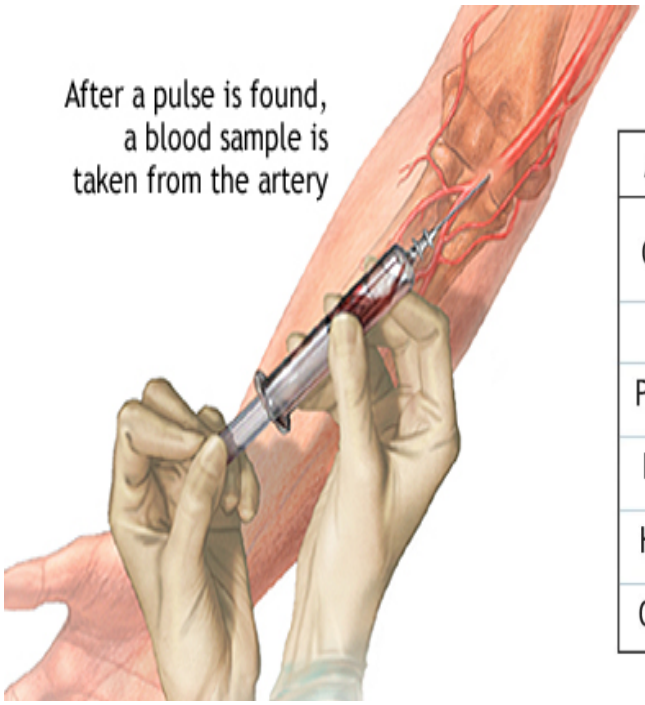


Fig 1. Blood veins and artery

2- Arterial Blood



ABG	Normal range
O_2CT	15-23% per 100 mL of blood
pH	7.35-7.45
$PaCO_2$	35-45 mmHg
PaO_2	80-100 mmHg
HCO_3	22-26 mEq/L
O_2Sat	95-100%

Fig2. Blood withdrawal from artery

Is a Deoxygenated blood, pumps from the right side of the heart to the lungs, where it takes up oxygen. The now oxygenated blood is pumped through the left side of the heart via arteries.
The most common reason for the collection of arterial blood is the evaluation of arterial blood gases. Arterial blood may be obtained directly from the artery (most commonly, the radial artery) by personnel who are trained to perform this procedure and are knowledgeable about the complications that could occur as a result of this procedure.

1. Arterial blood is used to measure arterial blood gases, like oxygen, CO2, and pH.
2. Arterial puncture is more difficult than the venous sample.
3. The Brachial and radial arteries are often used; the femoral artery is usually avoided because of bleeding.

3- **Capillary Blood**

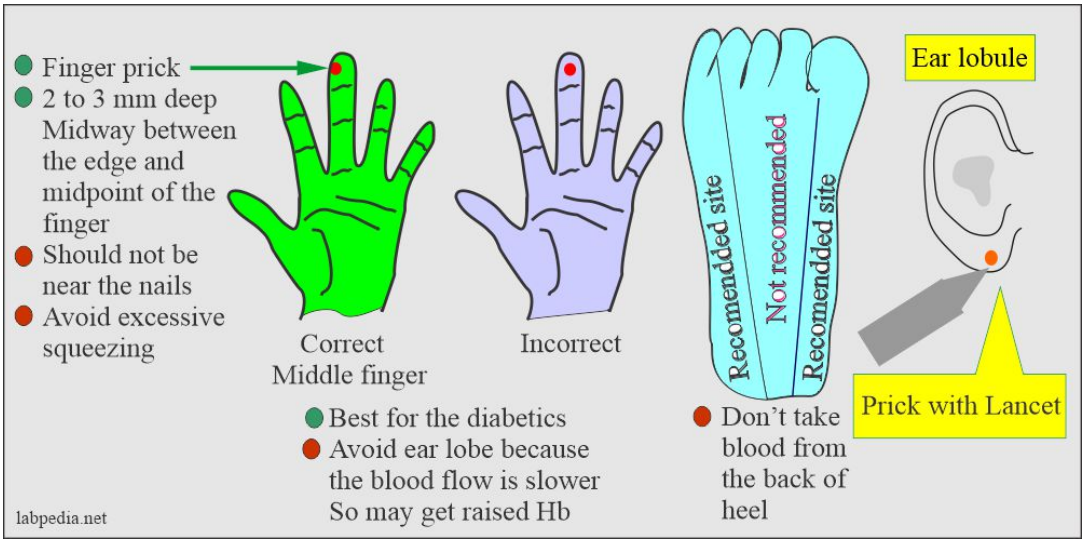


Fig.3. Capillary blood procedure sites

Capillary blood is obtained from capillary beds that consist of the smallest veins (venules) and arteries (arterioles) of the circulatory system. The venules and arterioles join together in capillary beds, forming a mixture of venous and arterial blood. The specimen from a dermal puncture will therefore be a mixture of arterial and venous blood along with interstitial and intracellular fluids.

Capillary blood is often the specimen of choice for infants, very young children, elderly patients with fragile veins, and severely burned patients. Point-of-care testing is often performed using a capillary blood specimen.

1. It is mostly used in the pediatric patient's group where there is no need for a large amount of blood.
2. The common sites are the fingertips, heel, and ear lobe. The heel is most commonly used in infants

Table.1. Blood specimen types1

Specimen Type	Method of Collection	Common Use
Venous	Direct puncture of vein by venipuncture; vascular access device	Routine laboratory tests
Arterial	Direct puncture of artery; vascular access device	Arterial blood gases
Capillary	Dermal puncture of fingertip or heel	• Infants and young children • Elderly patients with fragile veins • Severely burned patients • Point-of-care testing

Blood vein withdrawal: Step-by-Step

- Do a preliminary inspection (nonsterile) to identify a suitable vein: Apply a tourniquet, have the patient make a fist, and palpate using your index finger to locate a large-diameter vein that is non-mobile and has good turgor.
- To help distend and locate veins, tap a potential site with your fingertips. It may help to allow the arm to hang down, increasing venous pressure. Use a vein-finder device if a suitable vein is not readily seen or palpated.
- After identifying a suitable cannulation site, remove the tourniquet.

- Apply anesthetic if it is being used and allow adequate time for it to take effect (eg, 1 to 2 minutes for gas injector, 30 minutes for topical).
- Cleanse the skin site with antiseptic solution, beginning at the needle-insertion site and making several outwardly expanding circles.
- Wait for the antiseptic solution to dry completely. If applying povidone-iodine, wipe it off with alcohol and allow the alcohol to dry.

Criteria for the rejection of the blood sample:

1. Blood samples are not labeled or not properly labeled.
2. Insufficient blood quantity.
3. Blood sample showing hemolysis.
4. A wrong collection tube is used.
5. Insufficient quantity of the anticoagulants.
6. Improper transport of the sample.

The general considerations relevant to the accuracy of subsequent chemical analysis are:

1. Stasis (stop the blood flow by a tourniquet) should be used for a minimum period of time since prolonged stasis may result in alteration of some chemical values.
2. Blood should not be taken while intravenous solutions are being administered, since these solutions may influence the chemical assay.
3. Syringes or evacuated tubes use to collect blood should be valid (not expire) to avoid contamination or hemolysis.
4. Some tests require anticoagulants therefore, gentle mixing is necessary to avoid clotting.
5. Centrifugation and removal of serum or plasma from the cells helps preserve the integrity of many constituents.

6. Refrigeration is perhaps the simplest and most reliable method for preservation of specimens for several days. Glycolysis and other enzymatic and bacteriological processes are slowed down considerably at lower temp. Refrigerated samples should be brought to the room temperature before they can be measured accurately.
7. Freezing the whole blood results in rupture of the red cells, but it does not injure plasma or serum. Therefore, storage of plasma or serum is helpful in preserving most enzymatic activities.

Typed of Sample tubes

Table.2 **Summary of the color-coded blood collection tubes:**.

Outcome of additive	Purpose of use	Additives	Stopper tube	Name	Test tubes	
For serum	Chemistry Serology	N0 anticoagulant No additives	Red	Red or plain		1.

	Blood banking					
Anticoagulant, for plasma Remove calcium and prevent clotting. Invert tube 6 to 8 times	CBC CEA Best for hematology	EDTA	Lavender	EDTA tube		2.
anticoagulant binds calcium. Get blood or plasma	Coagulation studies Prothrombin Time, Activated Partial Thromboplastin Time	Sod. Citrate	Light Blue	Na-citrate tube		3.
Inhibit glycolysis Anticoagulant, remove Ca^{++} to prevent clotting. Get whole blood or plasma.	Glucose Glucose Tolerance Test Alcohol level	Na fluoride/K oxalate	Gray	Na-fluoride tube		4.
Prevent blood from clotting Stabilize bacterial growth Invert the tube 8 times to prevent clotting	Blood culture	Na^{+}polyanetholesulfate	Yellow	Acid-citrate-dextrose tube		5.
Clot activator shortens the time for clot formation. The gel forms a separator between cells and serum.	Most chemistry tests Not good for blood banking	Gel-separator Clot activator	Gold	Serum separating tube		6.

Invert tube 5 times and centrifuge after the clot formation						
Heparin prevents clotting The gel prevents cell contamination.	Potassium determination	Gel separator Lithium heparin	Light green	Heparin tube		7.
Binds Ca^{++} 4:1 ratio of blood to anticoagulant	Westgreen ESR determination	Na^{+} citrate	Black			8.