

# Oral Medicine

## ***LABORATORY INVESTIGATIONS***

### **Lecture 3**

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## **Laboratory investigation:**

**Are an extension of physical examination in which tissue, blood, urine or other specimens are obtained from patients and subjected to microscopic, biochemical, microbiological or immunological examination. As a result of information obtained from these investigations, the nature of the disease will be identified.**

## **Applications :**

- Confirming or rejecting of clinical diagnosis.**
- Providing suitable guidelines in patient management.**
- Providing prognosis information of the diseases under consideration.**
- Detecting diseases through case-finding screening methods.**
- Establishing follow – up therapy.**

## **Classifications :**

- **Hematological Tests.**
- **Biochemical Tests.**
- **Urinalysis Tests.**
- **Microbiological Tests.**
- **Immunological Tests.**
- **Cytopathological and Histopathological Tests.**

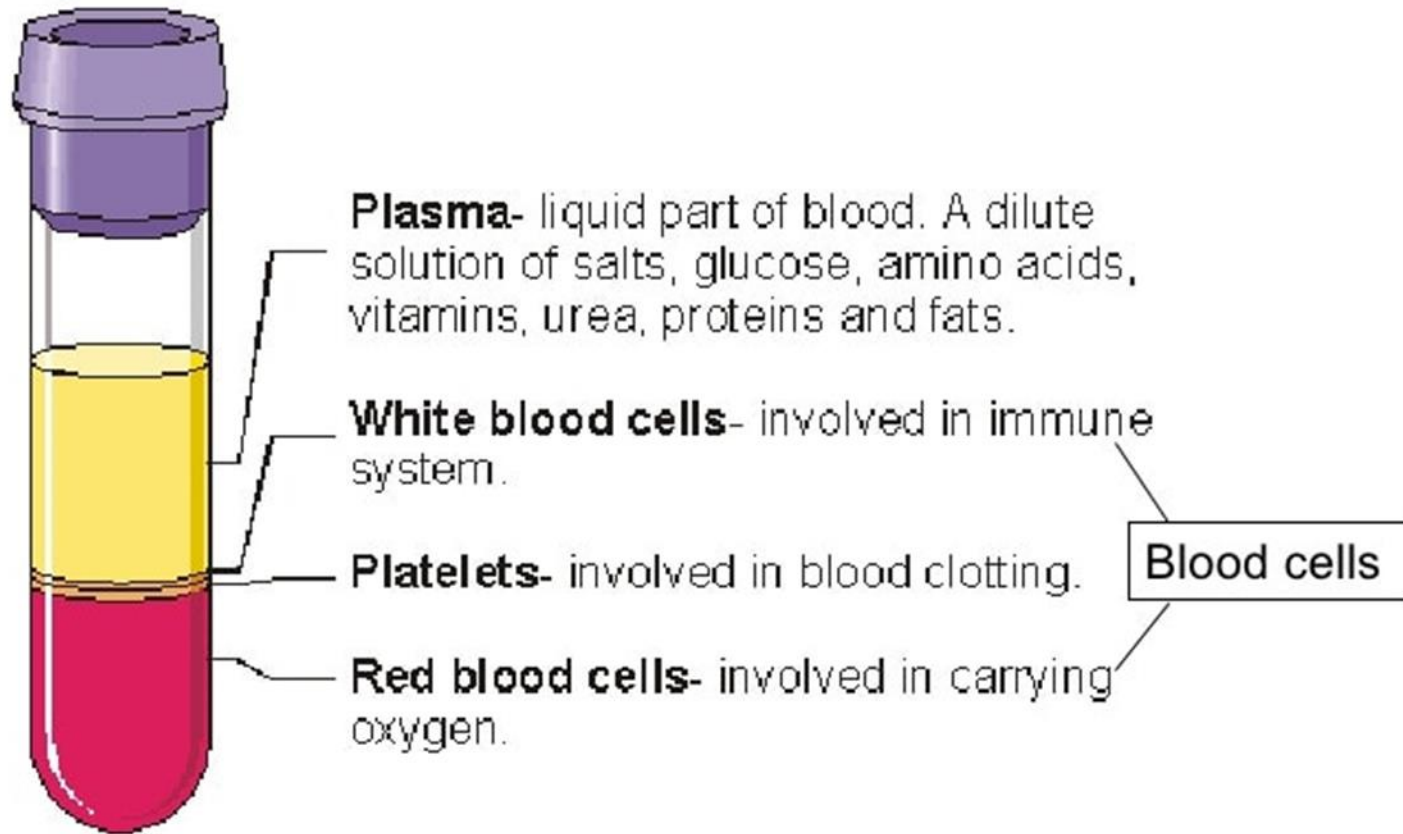
## Hematological investigations

Blood investigations are clearly essential for the diagnosis of diseases such as leukaemia, myeloma, or leucopenia which have oral manifestations, or for defects of haemostasis which can greatly affect management.

Blood investigations are also helpful in the diagnosis of other conditions such as some infections, and sore tongues or recurrent ulcerations which are sometimes associated with anaemia.

# Hematological Tests

main components in blood



## **Hemoglobin Concentration (Hb) :**

**Hemoglobin is the protein molecule in red blood cells that carries oxygen from the lungs to the body's tissues and returns carbon dioxide from the tissues back to the lungs.**

**It's normal value in male 13-17 g/dl while in female equal to 12-16 g/dl.**

**Increase means polycythemia while decrease value means anemia.**

## **Red Blood Cells Count (RBCs Count):**

**Normal red blood cells are round, flattened bi-concave disk shaped that are thinner in the middle than at the edges.**

**It is normal value in male 4-6million/ml, in female 4-5million/ml.**



RBC count is higher than normal (**erythrocytosis**). This may be due to :-

- Congenital heart disease
- Dehydration
- Renal cell carcinoma, pulmonary fibrosis
- Polycythemia vera, ( a bone marrow disease that causes overproduction of RBCs and is associated with a genetic mutation)
- When move to a higher altitude, RBC count may increase for several weeks because there's less oxygen present in the air.
- Certain drugs, such as Gentamicin and methyldopa, can also increase RBC count.
- Gentamicin is an antibiotic used to treat bacterial infections in the blood. Methyldopa is often used to treat high blood pressure and works by relaxing the blood vessels to allow blood to flow more easily through the body.
- A high RBC count may be a result of sleep apnea, pulmonary fibrosis, and other conditions that cause low oxygen levels in the blood.
- Performance-enhancing drugs such as protein injections and anabolic steroids can also increase RBCs.

## Lower than normal

If the number of RBCs is lower than normal, it may be caused by:

- Anemia
- Bone marrow failure
- Erythropoietin deficiency, which is the primary cause of anemia in patients with chronic kidney disease
- Hemolysis, or RBC destruction caused by transfusions and blood vessel injury
- Internal or external bleeding
- Leukemia
- Malnutrition
- Multiple myeloma
- Nutritional deficiencies, including deficiencies in iron, copper, folate, and vitamins B-6 & B-12
- Pregnancy
- Thyroid disorders
- Certain drugs can also lower RBC count, especially :
  1. chemotherapy drugs
  2. chloramphenicol, for bacterial infections
  3. Guanidine ,which can treat irregular heartbeats.



## **Haematocrit or packed cell volume (PCV):**

The number of RBCs per liter of blood. It's normal value in male 40-50% while in female 38-47%. Increase value in polycythemia or in case of dehydration and decrease in anemia or over-hydration.

## **Mean Corpuscular Volume (MCV):**

Measure of the average volume of RBC, normal value 80-95fl.

- Low MCV indicates microcytic (small average RBC size)
- Normal MCV indicates normocytic (normal average RBC size)
- High MCV indicates macrocytic (large average RBC size).

Increase mean macrocytic anemia & decrease mean microcytic anemia.

## **Mean Corpuscular Hemoglobin (MCH):**

The hemoglobin content (weight) of individual RBC, normal value 27-34pg.

Diminish value means hypochromic anemia (iron deficiency anemia).

## Mean Corpuscular Hemoglobin concentration (MCHC):

The amount of hemoglobin in 100ml of PCV, normal value 30-35g/dl.

It is increase means severe prolonged dehydration & hereditary spherocytosis.

It is decrease means hypochromic anemia.

## Red cell distribution width (RDW)

Measures the range of red cell size in a sample of blood, providing information about the degree of red cell anisocytosis.

**Anisocytosis:** It is a physical condition in which the red blood cells of a person are found to be of unequal size.

This happens when the patient suffers from: anemia, thalassemia or any other disorder of blood cells.

When blood is tested in such cases, the cells are found to be of different sizes. ( i.e. how much variation there is between the sizes of the red cells). e.g. low MCV with normal RDW suggests Thalassamia trait.

## Complete blood count (CBC)

It is measured using modern **haematology blood analyser's machine**, which includes measuring of the following parameters:

- **Hb concentration.**
  - **Red Blood cell count (RBC).**
  - **MCV.**
  - **MCH.**
  - **MCHC.**
  - **Hematocrit (Hct) or PCV.**
  - **Red cell distribution width (RDW).**
  - **White cell count.**
  - **WBC differential.**
  - **Platelet count.**
- The parameters such as MCV, MCH and MCHC had to be mathematically derived and calculated using the measured variables Hb, RBC and PCV.**

## Peripheral blood film (Stained blood smear)

- Examining a stained peripheral blood smear under the microscope allows the examination of red cells, white cells, and platelets (Number and morphology).
- To see the shape and size of RBCs to identify the etiological factor of anemia.
- In addition, it will help in detection of parasites (e.g. malaria, trypanosomes) or abnormal cells in the blood.

**- Usually we examine a peripheral blood film if the patient's indices are abnormal, or if we suspect an underlying blood disorder.**

### **Explanation of RBCs morphology:**

- a) Normocytic- Normochromic:** acute blood loss, chronic renal disease, pregnancy, cancer.
- b) Macrocytic- Normochromic:** Vit B12 deficiency, folic acid deficiency, liver disease (alcoholism).
- c) Microcytic- Hypochromic:** iron deficiency anemia, thalassemia, lead poisoning.

## Serum iron & Vit B12:

Levels of these are useful in diagnosis of anemia.

Serum iron= 60-170 mcg/dl

Vit B12=12-156 ng/ml.

## Serum ferritin

**Ferritin** This protein helps store iron in the body, and a low level of ferritin usually indicates a low level of stored iron.

Serum ferritin =20-300ng/ml.

## Total iron binding capacity (TIBC):

Is a blood test to see if there is too much or too little iron in blood. Iron moves through the blood attached to a protein called transferrin.

Normal value: 240 to 450 mcg/dL

- Ferritin a more sensitive indicator of body stores of iron than serum iron and total iron binding capacity.

# White Blood cells

White blood cells (WBCs), also called leukocytes, are an important part of the immune system. These cells help fight infections by attacking bacteria, viruses, and germs that invade the body. White blood cells originate in the bone marrow, but circulate through out the blood stream.

## White Blood cells Count (WBCs Count)

An average normal range is between 4,000 and 11,000 WBCs per microliter.

## Differential WBCs Count

### Normal values:

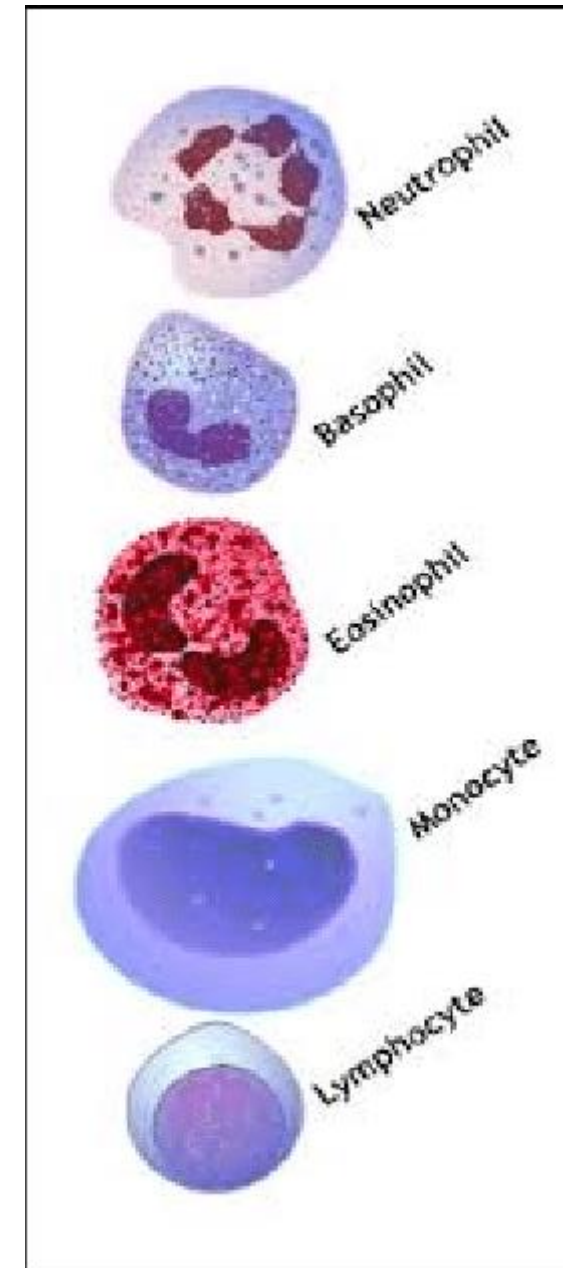
**Neutrophils (60-70%)**

**Lymphocytes (20-25%) (T & B lymphocytes)**

**Monocytes (3-8%)**

**Eosinophils (1-4%)**

**Basophils (0-1%)**



# Leukocytosis

Is the medical term used to describe a high WBC count.

**This can be triggered by :**

- **Anemia**
- **Tumors in the bone marrow**
- **Leukemia**
- **Inflammatory conditions, such as arthritis**
- **Stress**
- **Exercise**
- **Tissue damage**
- **Pregnancy**
- **Allergies**

# Leukopenia

Is the medical term used to describe a low WBC count.

**A low number can be caused by :**

- **HIV**
- **Autoimmune disorders**
- **Bone marrow disorders/damage**
- **Lymphoma**
- **Severe infections**
- **Liver and spleen diseases**
- **Lupus erythematosus**
- **Radiation therapy**

## **An increased lymphocyte count (lymphocytosis)**

Is seen in:- Infectious mononucleosis, viral infections, toxoplasmosis, T.B, syphilis, lymphocytic leukemia, chronic bacterial infections and multiple myeloma.

## **Decreased lymphocytes (lymphocytopenia)**

Is the hallmark of AIDS. It also occurs in acute infections, Hodgkin's disease, systemic lupus, renal failure and radiation.

## **An increased neutrophil count**

May indicate: Acute infection, gout, myelocytic leukemia, rheumatoid arthritis, rheumatic fever, acute stress, thyroiditis, trauma.

## **Decreased neutrophils (neutropenia):**

May occur in aplastic anemia, viral infections, chemotherapy and secondary to medications including:

Analgesics and anti-inflammatories, Antibiotics, Anticonvulsants, Antimetabolites, Antineoplastics, Antithyroid drugs, Barbiturates, Cardiovascular drugs, Diuretics.



- **An increased monocyte count**

May indicate: malaria, monocytic leukemia, chronic inflammatory disease, parasitic infection, tuberculosis, and viral infection.

- **An increased eosinophil count**

Occurs in allergic disorders, parasitic infection and Hodgkin's disease.

- **An increased Basophils count**

Occurs in in case of ulcerative colitis, leukemia, lymphoma.

# Platelets

❑ Normally 150.000- 400.000/mcL.

❑ Are critical to hemostasis and blood clot formation.

■ The number of platelets may be normal but their function impaired. **Impaired platelet function is assessed by obtaining bleeding times.**

■ **Increased platelets (thrombocytosis) :-**

Occur in many inflammatory disorders and myeloproliferative states as well as in acute or chronic blood loss, hemolytic anemia, after splenectomy, cirrhosis, and iron deficiency.

■ **Decreased platelets (thrombocytopenia ) :-**

Occurs in aplastic anemia, megaloblastic and severe iron deficiency anemia, uremia, autoimmune thrombocytopenia, thrombotic thrombocytopenic purpura, following massive hemorrhage, severe infections and as **a side effect of many different drugs including:-**

Carbamazepine, cimetidine, heparin, histamine blockers, most chemotherapeutic agents, non steroidal anti-inflammatories, quinidine, quinine, ranitidine, rifampicin.

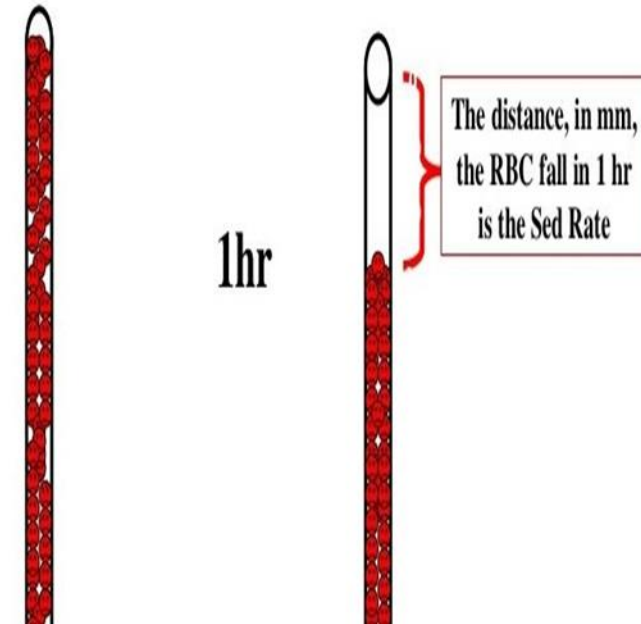
## Erythrocyte Sedimentation Rate (ESR) or plasma viscosity:

It is the rate at which RBCs precipitate in period of 1 hour.

It consider a global measurements of non-specific plasma proteins, it's normal value 0-15mm/hr.

It is a sensitive but non-specific index of plasma protein changes which result from inflammation or tissue damage, so ESR doesn't specifically diagnose any diseases, but it can provide information about whether or not there is inflammation in the body).

It increase in systemic inflammatory and autoimmune disorders particularly in giant cell arteritis & wegener's granulomatosis & rheumatoid arthritis, also in case of a fall of albumin level, bacterial infection, pregnancy and malignancy.



# Hematological investigations in bleeding disorders

## Bleeding time

It's a test of hemostasis (test of platelet function), it indicates how well platelets interact with blood vessel walls to form blood clots.

Bleeding time is used most often to detect qualitative defects of platelets. The bleeding time test is usually used on patients who have a history of prolonged bleeding after cuts, or who have a family history of bleeding disorders.

Normal range : 2-6 minutes (not more than 10) and greater than 15 minutes is considered significantly prolonged.

Increase in case of defect platelet function, thrombocytopenia, Von-willebrand disease and vascular disease.

Aspirin and other cyclooxygenase inhibitors can affect bleeding time, other medication like warfarin and heparin also increase bleeding time .

## Prothrombin Time (PT ) & International Normalized Ratio (INR )

They are used to determine the clotting tendency of blood.

The PT and INR tests evaluate the extrinsic and common coagulation pathways and screening for the presence or absence of fibrinogen (F I), prothrombin (F II), and Fs V, VII, and X.

**PT:** Normally 10-14 sec, increase in case of warfarin treatment, liver disease, vit k deficiency, deficiency of factor (I,II,V,VII,X).

**INR:** Is the ratio of patient's PT to that of normal PT, it's a way of standardizing the results of PT test.

The international normalized ratio ranges between 1 and 1.5 for a person who is not taking anticoagulant medication and 2.0 to 3.0 for people taking warfarin and other blood-thinning drugs.

In addition, to its primarily used to diagnose unusual bleeding and blood clotting. It is used in monitoring people being treated with warfarin.

An INR lower than the desired range means the blood is “not thin enough” or clots too easily, an INR result higher than the desired range means the blood is “too thin”.

### **The partial thromboplastin time (PTT) or activated partial thromboplastin time (APTT)**

Normal reference range is between 30-50 sec.

The prolong APTT may indicate the use of heparin, hemophilia or deficiency of coagulation factors (I,II,V,VIII,IX,X,XI,XII).

It is also used to measure the activity of heparin, or other para proteins that inhibit conversion of fibrinogen to fibrin.