Complete Blood Count

- *White Blood Cell Tests* -

White blood cells, also called leukocytes, are spherical cells; whitish in color; have a nucleus. leukocytes consider a part of the body's immune system; they destroy and remove old or abnormal cells and fight infectious agents and foreign substances; also produce antibodies as part of the immune response to a foreign substance.

WBCs types are divided into two main groups according to their appearance:

Granulocytes: are polymorphonuclear cells (nuclei are segmented into several lobes of varying shapes), containing large cytoplasmic granules. Their types are:

- ***Neutrophils*** consist approximately 62% of total WBCs.
- ***Basophils*** consist about 0.4% of total WBCs.
- ***Eosinophils*** consist about 2.3% of total WBCs.

Agranulocytes: are mononuclear cells, containing very small cytoplasmic granules. Their types are:

- ***Lymphocytes*** consist approximately 30% of total WBCs.
- ***Monocytes*** consist about 5.3% of total WBCs.

Total Leukocytes Count (TLC)

Principle:

Blood sample is diluted with Turk's fluid *(WBC dilution fluid)* which causes lyses of RBCs & platelets; and staining of WBCs to facilitate counting by the hemacytometer. The total numbers of WBCs are calculated per mm3 of blood.

Procedure:

1. Aspirate blood exactly up to mark 0.5 of WBC pipette than diluting solution (Turk's fluid) up to 11 mark, thus making 1:20 dilution of blood.

2. Hold the pipette horizontally and rotate it gently to ensure the mixing of blood and fluid; and gives a suspension of WBCs in the pipette's bulb.

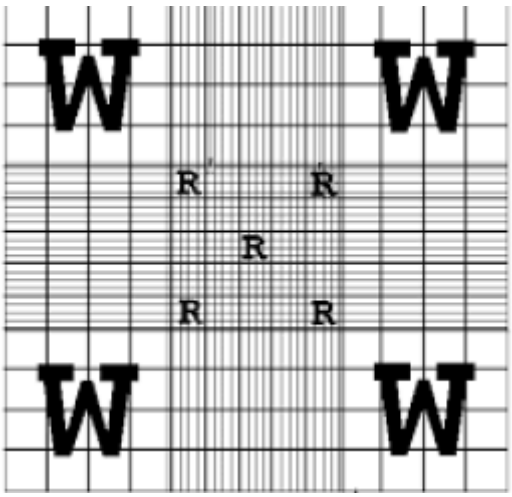
3. Discard the first drops of fluid from the WBC pipette to remove the pure diluting fluid in the stem.

4. A small drop of fluid in the tip of pipette is gently brought in contact with edge of the cover slip. The fluid is drawn into the chamber by capillary action.

5. Leave for 2-3 minutes for cells to settle down in the counting chamber.

6. Under X10 objective of the microscope, count the WBCs in four-corner WBC squares (each square includes 16 small squares).

7. Any cell lies on upper and left lines of a square is counted, omit the cells lies on lower and right lines of a square.



Calculations:

A- Dilution Factor = Volume of solution (10) Volume of sample (0.5) = 20

B- Volume of fluid = squares area (4 mm2) X chamber depth (0.1 mm) = 0.4 mm3

C- Total WBC count = N X Dilution factor (20) Volume of fluid (0.4) = N X 50

N is the number of WBCs found in 4 square

Normal Ranges

- Adults: 4.000 – 11.000 / mm3
- Six years: 4.500 – 12.000 / mm3
- One year: 6.000 – 14.000 / mm3
- Newborn: 9.000 – 30.000 / mm3

Variations:

Leukocytosis: WBCs increased conditions (WBC >11*103/mm3):

1. During pregnancy and birth.
2. Microbial infection such as tonsillitis, tuberculosis, pertussis; and infection by some viruses such as measles, hepatitis.
3. Infection with parasites as malaria.
4. Allergic disorders such as asthma, allergic skin diseases.
5. Cancer and leukemia.

Leukopenia: WBCs decreased conditions (WBCs < 4.5*103/mm3):

1. Acute viral infections, such as a cold or influenza.
2. Disease systemic lupus erythematosus.
3. Disease of liver or spleen.
4. Typhoid and paratyphoid diseases.
5. Bone marrow failure.
6. Aplastic anemia

7. Exposure to radiation, chemotherapy.

8. Certain medications such as minocycline, metronidazole, immunosuppressive drugs.

Differential Leukocytes Count (DLC)

In a normal blood film, the five different types of normal white blood cells *(neutrophils, basophils, eosinophils, monocytes and lymphocytes)* can be seen.

***Principle**:*

The dry stained blood film is examined in order to determine and assess the percentage and the count of each WBCs type.

Procedure:

1. Prepare blood film by smear mothed.

2. Pour Leishman stain on slide, just enough to cover blood smear. leave it for 2 min (fixation time)

3. Added double volume of buffered or distilled water over the stain and mix them gently. Leave the stain for 10 minutes to allow the stain to act (staining time).

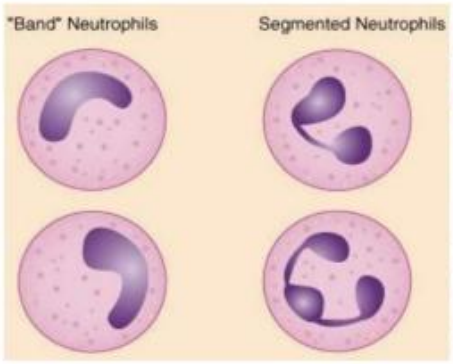
4. Wash the stain in distilled water, then dry the slide.

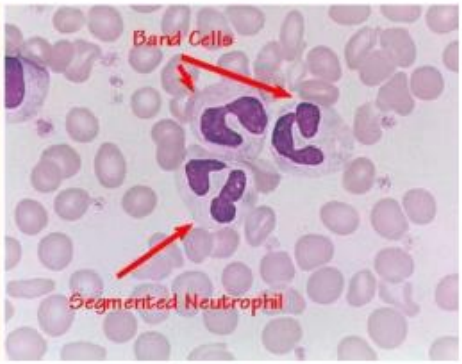
5. Examine the dry film under microscope. Focus the film at X100 objective and choose a suitable area, where cells are evenly distributed.

6. A total of 200 cells should counted, and every WBC seen should be recorded in a table tallied as: *(neutrophils, basophils, eosinophils, monocytes, lymphocytes)*.

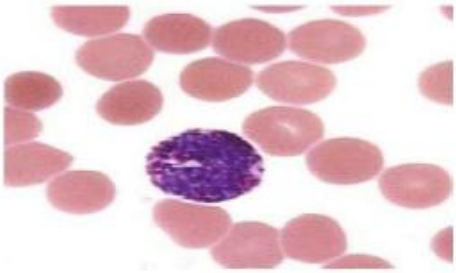
7. Find the number and percentage of each type of WBCs present in the sample

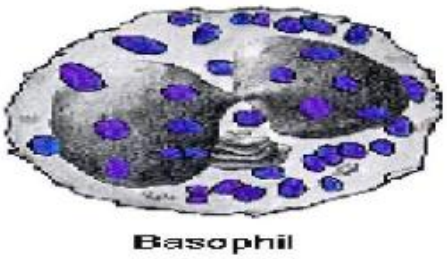
Neutrophils



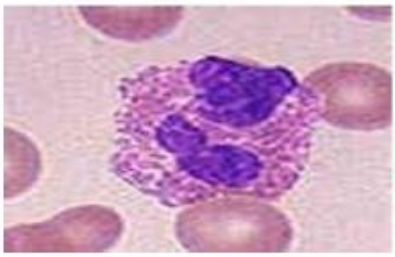


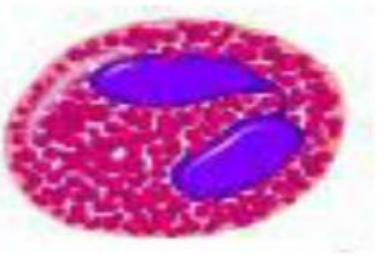
Basophils



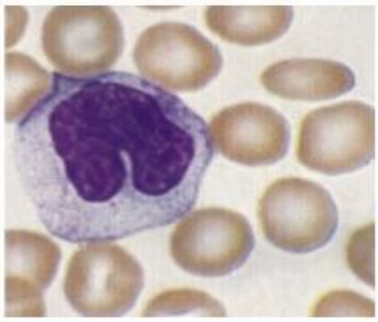


Eosinophils

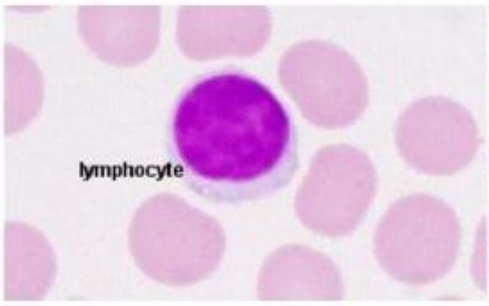


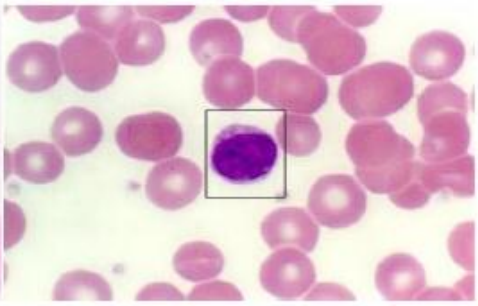


Monocye



Lymphocytes





WBC type	Level	Disorders
Neutrophils	decrease	– chemotherapy and radiation exposure – influenza
	increase	– gout – rheumatoid arthritis
Basophils	decrease	– acute allergic reaction
	increase	– skin inflammation – parasite infections
Eosinophils	decrease	– asthma
	increase	– an allergic reaction – parasitic infection
Lymphocytes	decrease	– HIV infection
	increase	– leukemia – viral infection, such as the mumps or measles
Monocytes	decrease	– skin infections
	increase	– chronic inflammatory disease – tuberculosis

Notes:

 High WBC count with an increase in granulocytes indicates a bacterial infection.

 High WBC count with immature WBC present indicates leukemia.

 Low WBC count with an increase in the lymphocytes indicates a viral infection.

 High WBC count with an increase in the neutrophils and decrease in the lymphocytes may indicates COVID-19.