

اسم الله
الجليل



BLOOD

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Agenda

- Types of blood cells.**
- Structure of RBCs.**
- Structure of WBCs.**
- Structure of platelets.**



ILOs

- Differentiate between types of blood cells.**
- Identify structure of film and its contents.**
- Demonstrate the structure and function of RBCs, platelets, and types of WBCs.**



BLOOD

Specialized connective tissue in which cells are suspended in fluid extracellular material called plasma

Contents:

1-Formed elements (blood cells):

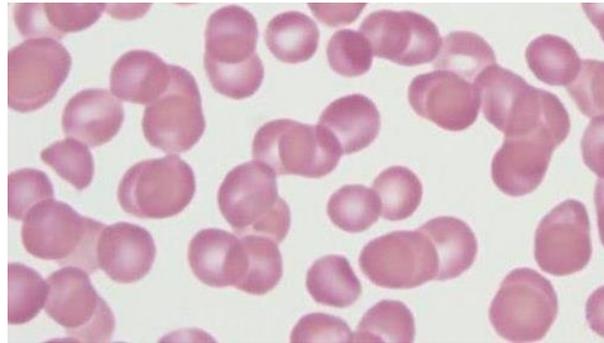
They form about 45% of the blood volume.

The Blood cells are:

- a) Red cells (erythrocytes).**
- b) White cells (leukocytes).**
- c) Blood platelets (thrombocytes).**

2-Plasma: it forms 55% of the blood volume.

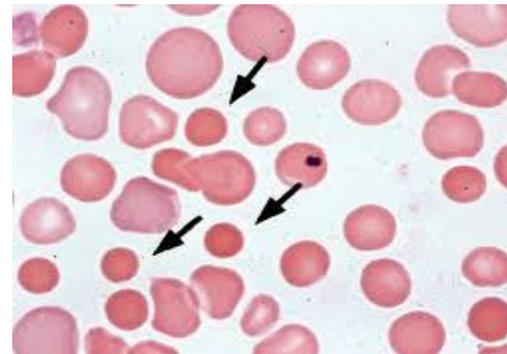
RED BLOOD CORPUSCLES (RBCS) (ERYTHROCYTES)



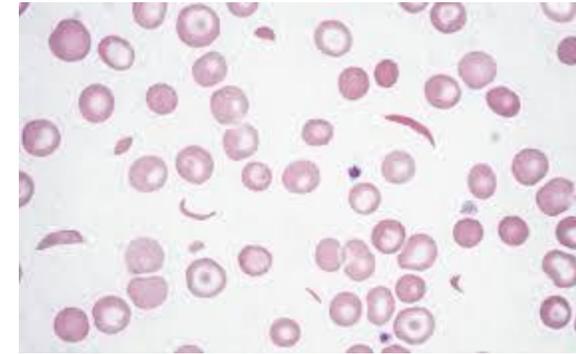
A- Shape:

- **biconcave disc shape.**
- **Abnormal shapes:**
 1. **Spherocytosis:** spherical or biconvex.
 2. **Sickle shape:** in sickle cell anemia.
 3. **Crenation:** shrinkage of RBC when exposed to hypertonic solution.
 4. **Swelling:** when exposed to hypotonic solution.

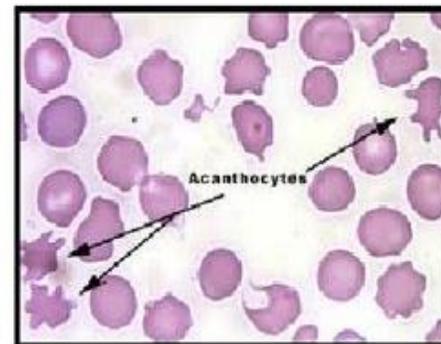
Spherocytosis



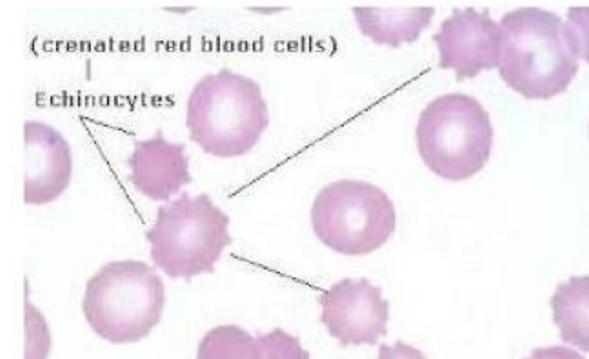
Sickle shape



Crenation



Swelling



B- Size:

- **Normal diameter:** 6-9 μm (average 7.5 μm).
- **Abnormal size:**
 1. **Macrocytic anemia:** diameter $> 9 \mu\text{m}$.
 2. **Microcytic anemia:** diameter $< 6 \mu\text{m}$.
 3. **Anisocytosis:** variable diameters.



C- Number:

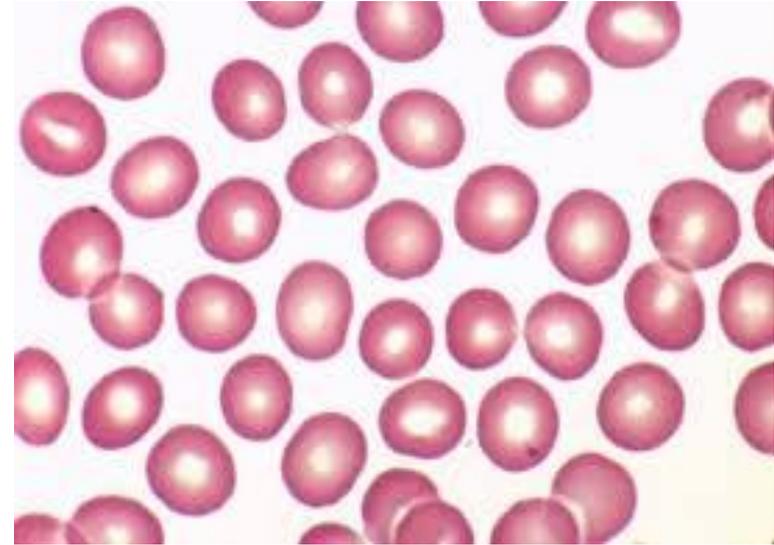
- **In males:** 5 - 5.5 million / mm^3 .
- **In females:** 4.5 - 5 million / mm^3 (due to loss of blood during menstruation and depression of bone marrow by female sex hormones).

Abnormal number:

- 1- **Anemia:** Decrease in the number
- 2- **Polycythemia:** Increase in the number

D- Color:

- **Single RBC is greenish yellow due to minimal HB.**
- **Drop of blood appears red as it contains a large number of RBCs.**
- **In stained sections, RBCs with normal HB appear acidophilic with pale center (normochromic).**
- **RBCs with less HB → pale (hypochromic).**
- **RBCs with more HB → deeply stained periphery with stained center (hyperchromic).**



Abnormalities in Hb content – coloring



hypochromic



normochromic



hyperchromic



E- Structure of RBCs:

- They are non-nucleated cells (now called corpuscles).
- They have no organelles but filled with HB.
- Plastic cell membrane which has selective permeability.
- They contain important enzymes e.g. carbonic anhydrase enzyme.

Adaptation of RBCs to its function:

1. **Biconcave shape** increases surface area for more gas exchange.
2. **Absence of nuclei and organelles** allows more space to HB for gas exchange.
3. **Carbonic anhydrase enzyme** plays an important role in transportation of CO₂ from tissues to the lung.
4. **Selective permeability** of the cell membrane allows exchange of O₂ and CO₂ but not HB.
5. **Plastic cell membrane** allows RBCs to be squeezed in narrow vessels.



LEUCOCYTES (WBCS)

True nucleated cells having cell organoids, cell inclusions, but no hemoglobin.

Color:

Single WBC is colorless (leucocyte) but when aggregated, they appear white (WBCs).

Number: 4,000-11,000/mm³.

Abnormal number:

- 1- Leukocytosis: WBCs $>$ 11000 per cubic millimeter.
- 2- Leukopenia: WBCs $<$ 4000 per cubic millimeter.

CLASSIFICATION OF LEUCOCYTES:

Granulocytes

Neutrophil



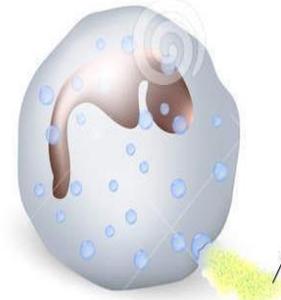
(phagocytosing a bacteria and other pathogens)

Eosinophil



(control mechanisms associated with allergy)

Basophil
(contain histamine and heparin)



Histamine release from the basophils

Granular Leucocytes

- Neutrophils
- Eosinophils
- Basophils

Non-granular Leucocytes

- Lymphocytes
- Monocytes

Agranulocytes

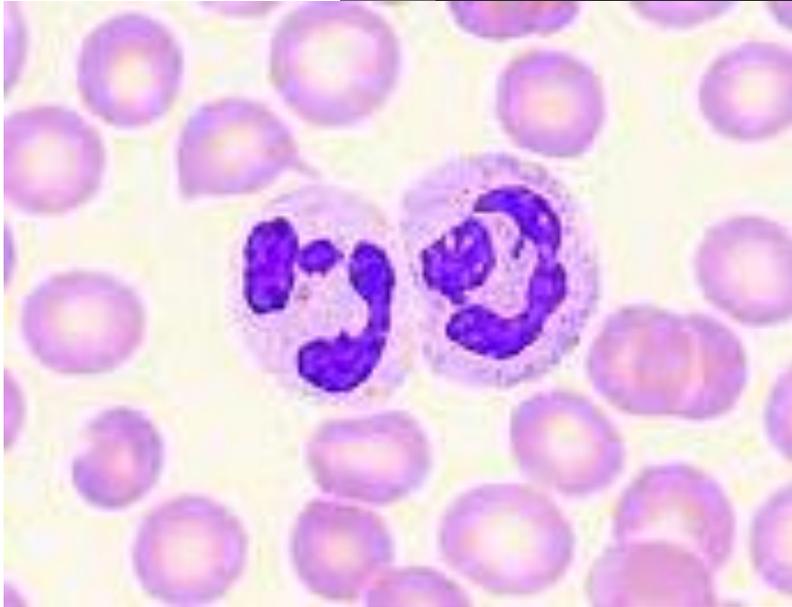
Monocyte
(phagocytosis)



Lymphocyte
(secretion of antibodies)



Neutrophils



Percentage

- 60-75% of total leucocytes.

Nucleus

- Single, dark stained and **segmented** (2-5 segments connected by fine chromatin threads).

Cytoplasm

- contains fine neutrophilic granules.



E/M:

- Few mitochondria and endoplasmic reticulum.
- Three types of granules are present:
 - 1. Specific granules:**
 - Numerous & small in size.
 - Contain bacteriostatic and bactericidal substances.
 - 2. Azurophilic granules:**
 - Few in number & large in size.
 - Contain hydrolytic enzymes (lysosomes).
 - 3. Glycogen granules**

Function:

1. **Defense** against microorganisms.
2. They also secrete **proteolytic enzymes**.
3. During infections, they stimulate the bone marrow to produce more leucocytes (**neutrophilia**).
4. They attract **monocytes** to the infected area.

Eosinophils

Percentage

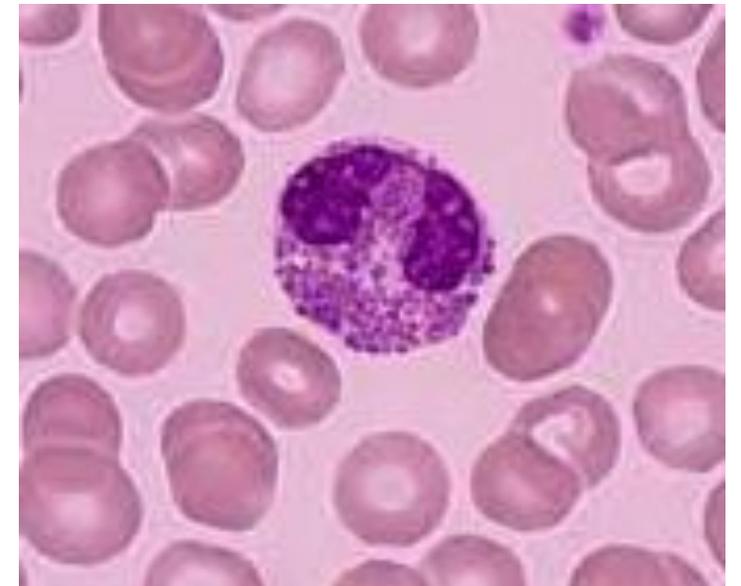
- 2- 5% of total leucocytes.

Nucleus

- Bilobed “horseshoe shaped”.

Cytoplasm

- contains acidophilic refractile granules.

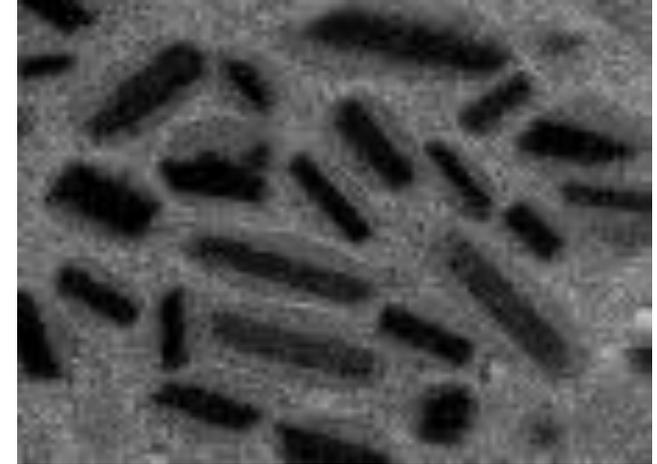


E/M:

- Few mitochondria, rER, and Golgi.
- **Coarse ellipsoid granules**, with electron dense crystalloid core in the center and electron lucent periphery.
- These granules contain **histaminase** and **sulphatase** enzymes.

Function:

1. **Anti-allergic** action through:
 - They can phagocytose the antigen-antibody complex.
 - They secrete histaminase and sulphatase enzymes which destroy histamine and sulphate substances of allergy.
2. **Antibilharzial** and **antiparasitic** action.



BASOPHILS

Percentage

- 0.5 - 1% of total leucocytes.

Nucleus

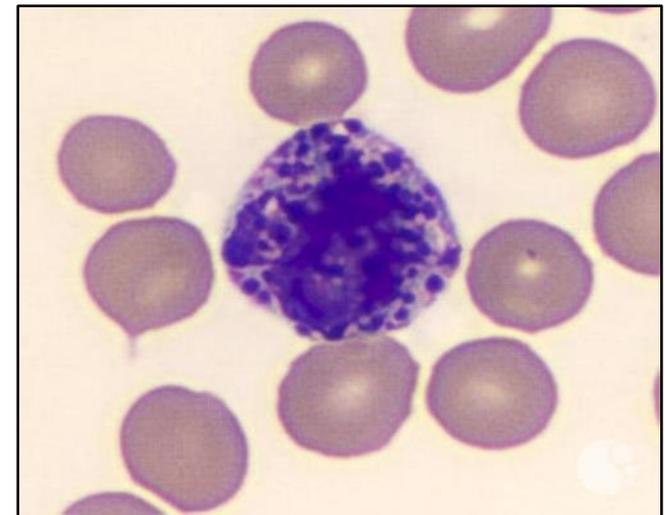
- Large and irregular.

Cytoplasm

- Filled with **large basophilic granules** which are similar to the granules of mast cells in:
 - Contain **histamine and heparin**.
 - Can **respond to antigens**.
- These granules can be stained by metachromatic stain and Giemsa stain.

Function:

1. They produce heparin and histamine during allergy.
2. They have minimal phagocytic activity.
3. They release eosinophil chemotactic factor.





LYMPHOCYTES

Percentage

- 25-30%.

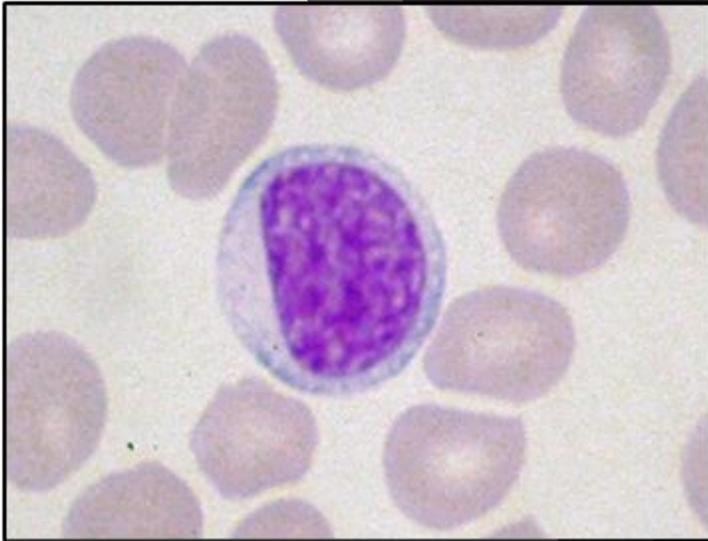
Classification:

- 1. Small-sized lymphocytes: 4-7 μm .
- 2. Medium-sized lymphocytes: 7-10 μm .
- 3. Large-sized lymphocytes: 10-15 μm .

NB:-

- Lymphocytes found in the blood are mainly small and medium sized, while the lymphoid organs contain the three types.

Large or medium-sized lymphocytes



Percentage

5 - 10% of total leucocytes.

Nucleus

Large, pale and indented.

Cytoplasm

abundant, more basophilic and non granular.

Small-sized lymphocytes



Percentage

- 15 - 20% of total leucocytes.

Nucleus

- Central, round and dark.
- Surrounded by a thin rim of cytoplasm.

Cytoplasm

- few in amount & pale basophilic.



Classification:-

1.B. cells.

2.T. cells.

B. LYMPHOCYTES

T. LYMPHOCYTES

Development :

In bone marrow

In the thymus

Percentage :

30%

70%

Function :

Humoral immunity

Cell mediated immunity

Types :

1.B.lymphocytes of humoral immunity.

2.B.memory cells.

1.T. killer cells: produce cytotoxic substances.

2.T. memory cells

3.T. helper cells.

4.T. suppressor cells.

5.Lymphokines secreting cells.

Monocytes

Percentage

3-8%.

Nucleus

large, pale and kidney shaped.

Cytoplasm

Abundant and appears pale blue.

Shows positive peroxidase reaction.





E/M:

- Many **microvilli** and **pinocytotic vesicles** near the cell surface.
- Few cell organelles, small Golgi and **azurophilic granules (lysosomes)**.

Function:

Penetrate the capillaries and venules to reach the C.T. and transform into **macrophages**.



PLATELETS (THROMBOCYTES)

They are fragments of cytoplasm covered with membrane but have no nucleus (not true cells).

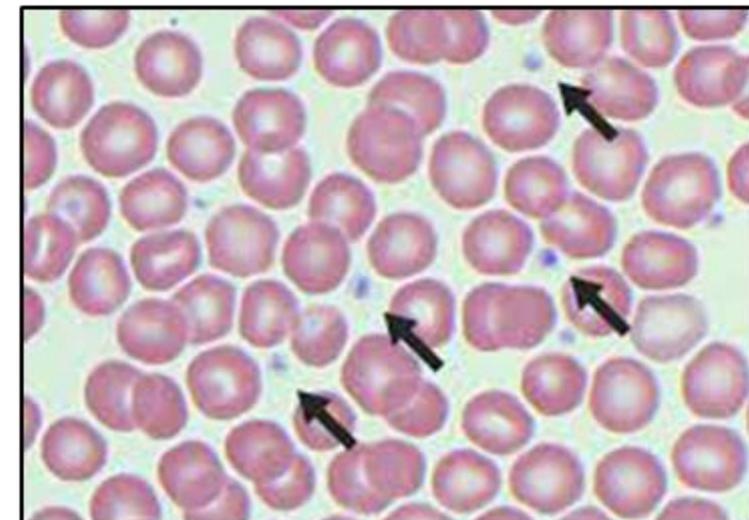
Size: 2 - 4 μm .

Shape: oval or rounded discs.

Number: 150.000 - 400.000 / mm^3 .

L/M:

- **Appear as oval or rounded non nucleated discs.**
- **Their outer part appears transparent and pale blue (called **hyalomere**).**
- **Their central part contains dark stained granules (called **granulomere**).**



E/M:

1- Cell membrane:

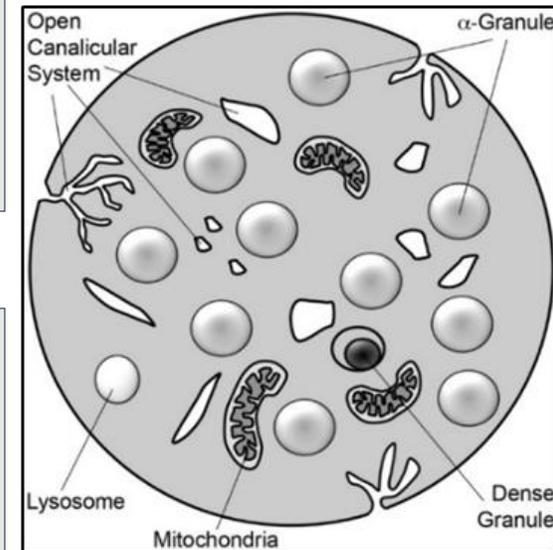
- Irregular and covered with a thick cell coat.

2- Hyalomere:

Tubules & vesicles invaginated from the cell membrane.
Actin-like microfilaments and microtubules.

3- Granulomere:

- Alpha granules:** contain fibrinogen.
- Beta granules:** mitochondria.
- Delta granules:** contains serotonin, ATP, ADP and calcium.
- Lambda granules:** lysosomes.
- Glycogen granules.**



Function:

Stop bleeding (hemostasis).



Thank You!

Dr. Dalia Eita

References

- **Junqueira LC, Carneiro J: Junqueira's Basic Histology. Text and Atlas, fourteenth edition, Copyright © 2016 by McGraw-Hill Education.**
- **Student medical histology book, Mansoura university.**