

Block HEM-210

Blood

Second year

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THE BLOOD

Blood is considered as a special type of C.T :

▪ It is composed of:

1. formed elements: erythrocytes, leucocytes and blood platelets suspended in an extracellular fluid
2. an extracellular fluid matrix: the blood plasma.

RED BLOOD CORPUSCLES (RBCs)

(ERYTHROCYTES)

- These are minute corpuscles that give a red color to the blood. They are non true cells consist of membrane-bounded corpuscles containing cytoplasm that consists predominantly of the pigment hemoglobin

- The life span of R.B.Cs is about 100-120 days.

At L.M. level:-

- They appear acidophilic non-nucleated cells and have biconcave shape **(Fig. 1)** .This shape increases surface area for saturation of its hemoglobin with oxygen .
- The discoid erythrocytes form aggregates that resemble stacks of coins called rouleaux . This happens only in stagnant blood in vitro but not in the circulating blood.

- Abnormalities in the shape of RBCs e.g. sickle cell anemia (**Fig. 2**).



Fig. (1): Scanning electron micrograph of erythrocytes showing their Biconcave shape.



Fig. (2): Scanning electron micrograph of an erythrocyte in sickle cell anaemia.

Ultrastructure of Erythrocytes

- Cell organelles are lacking.
- Hb molecules form dense homogenous content of a granular texture.
- Immediately beneath the membrane, there is a network of membrane skeleton: which makes R.B.Cs. to be quite pliable when flowing through narrow capillaries(**elasticity**).

Characters of RBCs:-

Size:

- Normal R.B.Cs varies from 6-9 um in diameters and about 1.9 um in thickness. These are called **normocytes**.

Number:

- The normal number of erythrocytes is about 5.4 million/cu mm. in males and about 4.8 million/cu mm. in females.
- The decrease in number of R.B.Cs is called **anaemia or oligocythemia**. The increase in number of R.B.Cs is called **polycythemia**.

Color :

- The normal color of R-B.Cs is greenish or orange yellow. When they condense, the color is red. The color of R.B.Cs gives rough indication to its hemoglobin (Hb) content. The normal color of R.B.Cs is called **normochromic**.
- The decrease in amount of Hb content resulted in **hypochromic** R.B.Cs.

- The increase in the amount of Hb result in **hyperchromic** R.B.Cs.
- Hypochromic anemia occurs in iron deficiency anemia.

Hemoglobin:

- It is the main constitute of R.B.Cs. Normal Hb in adult human is called HbA.

Function:

R.B.Cs carry O₂ to tissues and CO₂ from tissues to the lungs.

WHITE BLOOD CELLS (W.B.Cs) (LEUKOCYTES)

Differences between WBCs and RBCs

- Leucocytes are colorless do not contain pigment
- they contain granules.
- Leucocytes are capable of amoeboid movement.
- They perform their function in the C.T.
- They are larger in diameter.

Number:

The total leukocyte count in the circulation ranges from 5000 to 9000/cu mm.

Classification of Leucocytes:

Leucocytes are classified as granular and non-granular depending on whether they do or do not contain **specific granules** in their cytoplasm.

note: Both types contain non-specific granules in their cytoplasm (Azurophilic non-specific granules are primary lysosomes)

1- **Granular leucocytes** are; neutrophils, eosinophils and basophils

2- **Non-granular leucocytes** include lymphocytes and monocytes.

The relative number of each type of leucocyte is called **the differential leucocytic count**.

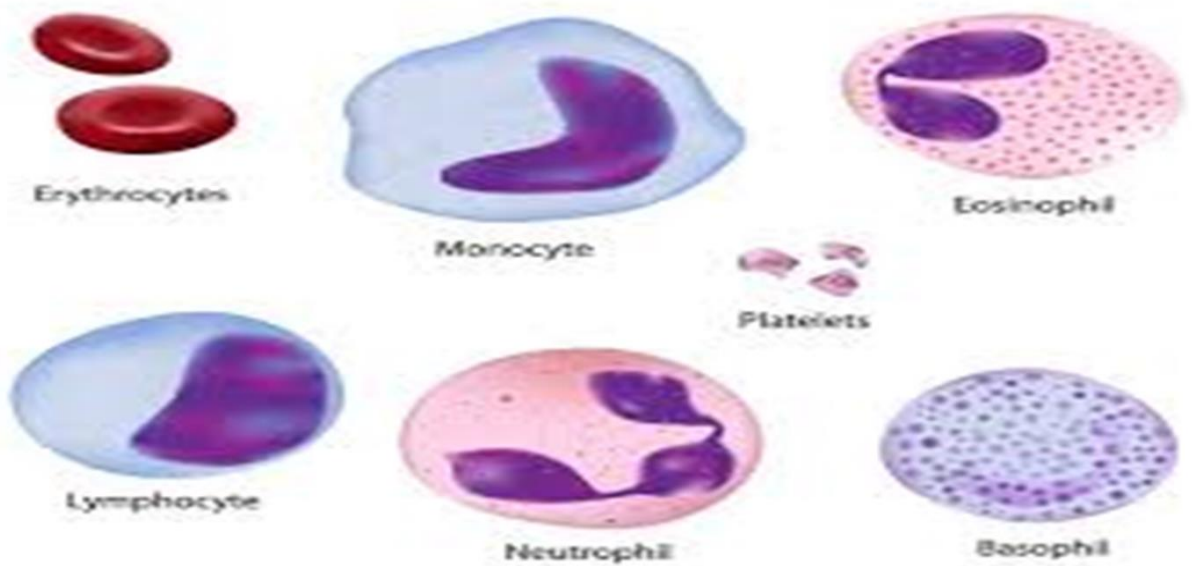
- Neutrophils constitute 55-60%,
- eosinophils 1-3%,
- basophils 0.0-0.7%,

- lymphocytes 25-33%
- Monocytes 3-7%.

Clinical notes:-

An increase in the number of leucocytes is called **leukocytosis** while its decrease is called **leucopenia**.

The Elements of Blood



Neutrophil Leucocytes:

- Neutrophils are the most abundant of the granular leucocytes.
- Diameter of granular leukocytes about 10-12 μm .
- **By L.M**
 - 1- The nucleus : multilobed(more than 2lobes connected by chromatin thread).
 - 2- The cytoplasm is stippled with very fine specific granules stain faintly pink, and somewhat larger azurophilic non-specific granules.

• **By E.M. (Fig.3)**

- The cytoplasmic granules of neutrophils are of two main types:
 1. Azurophilic primary non-specific granules or lysosomes are large ,dense vesicle
 2. Specific secondary granules are smaller and less dense ,

Functions:

1)

Neutrophils

are the body's first line of defense against invasion of **bacteria** by phagocytosis. So that it increases in **acute pyogenic infection**

They are called **polymorphs**, **polymorpho-nuclear** leucocytes or **tissue microphages**.

2)

Activated neutrophils migrate to infected or injured sites also .

They release **chemokines** that attract other leukocytes as eosinophils and monocytes to site of injury.

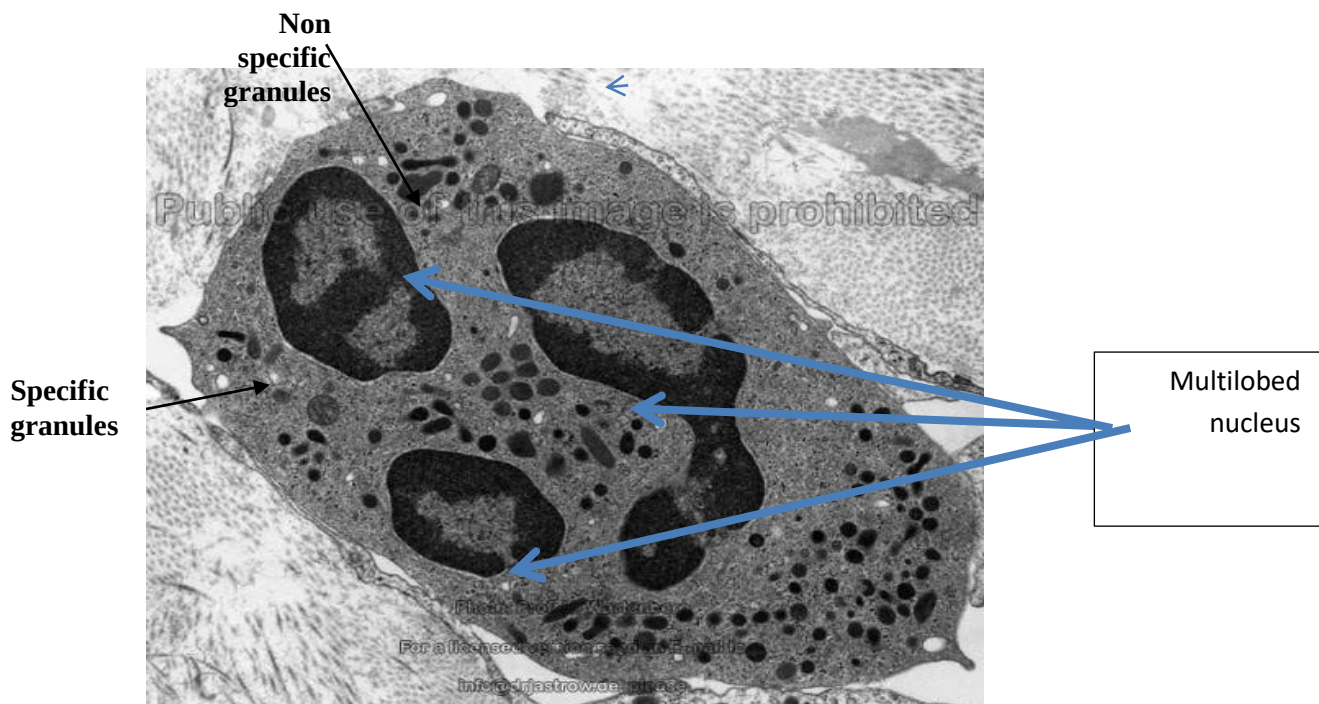


Fig. (3): electron micrograph of neutrophil.

Eosinophil Leucocytes

Represent only 1 -3% of blood leucocytes.

By L.M:

- The nucleus is bilobed.
- The cytoplasm contains large eosinophilic refractile granules.

By E.M. (Fig. 4):

- The specific granules contain dense crystalloid core included in amorphous matrix. The granules contain major basic proteins.

• **Functions:**

- **Phagocytic for antigen-antibody complexes.**
- **Defense against parasites:**

By antiparasitic enzymes released from their specific granules.

- **control allergy by secreting histaminases which inactivate the histamine produced by other cells**
- **In chronic inflammation:** Eosinophils are particularly abundant in connective tissue of the intestinal lining and at sites of chronic inflammation

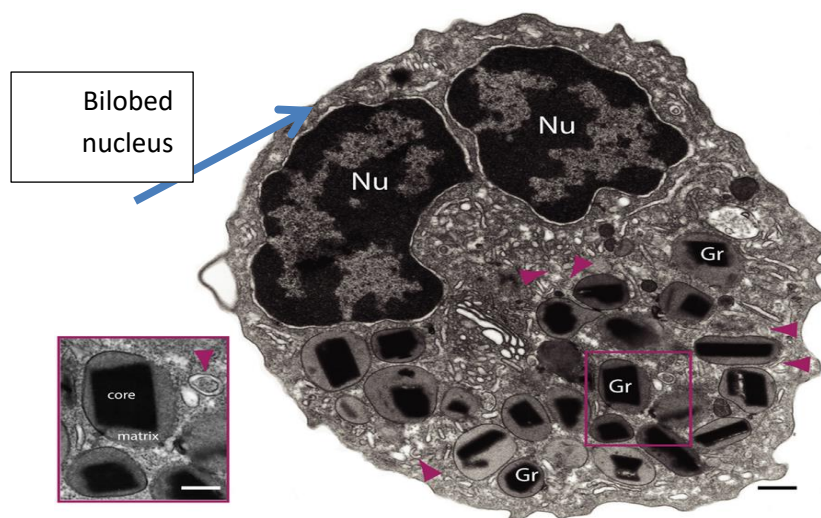


Fig. (4): Diagram of an eosinophil by E.M

Basophil Leucocytes:

- **By L.M.**

- The nucleus is U or S shape.
- The specific granules are relatively few, large and basophilic.

By E.M(Fig.5): The cytoplasm contains;

- The specific granules are large dense rounded and they contain histamine and heparin like mast cells.

- **Function:**

- On degranulation release of basophilic mediators(histamine) from specific granules causing allergic reaction or anaphylactic shock.

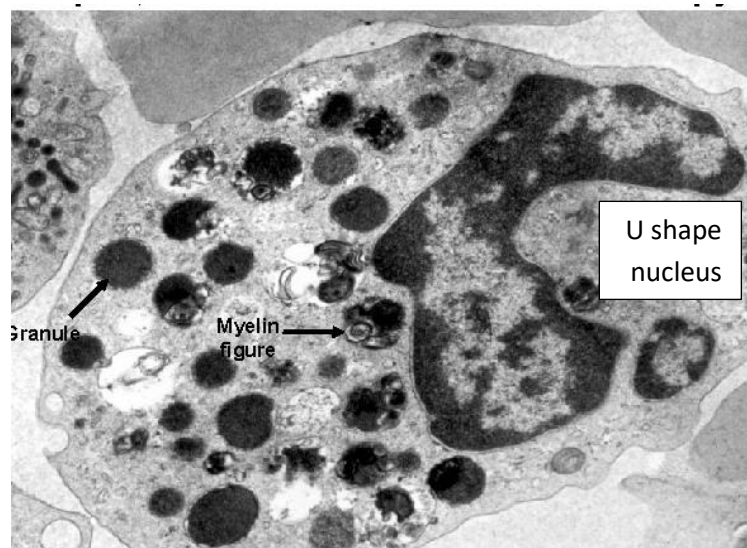


Fig. (5): Diagram of a basophil by E.M.

Lymphocytes

- 25-33% of leukocytes.

Previously discussed in lymphatic system- see fig

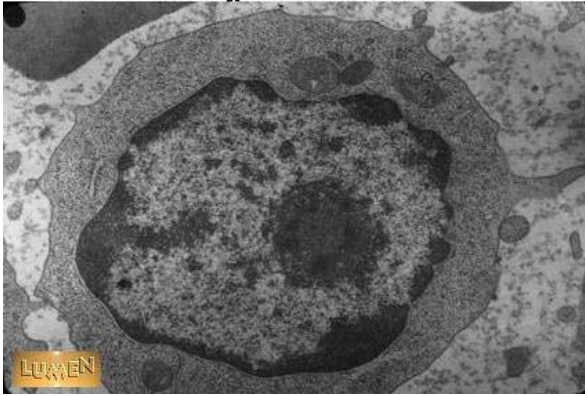


Fig. (6): Diagram of a lymphocyte by E.M.

Monocytes:

- Account for 3-8% of total leucocytes.
- Measure about 12-20 μm . in diameter in stained blood film (largest cell in blood film).
- **By L.M.:**
 - The nucleus is eccentric and commonly kidney shapes.
 - The cytoplasm is pale blue contains few azurophilic granules.
- **EM: Fig. (7):**
- **Function:**
 - 1- capable of developing into macrophage: circulate in the blood for 1-2 days and then migrate into the C.T. where they differentiate into tissue macrophages.
 - 2- They also act as antigen presenting cells capable of processing antigen and presenting it to T lymphocytes

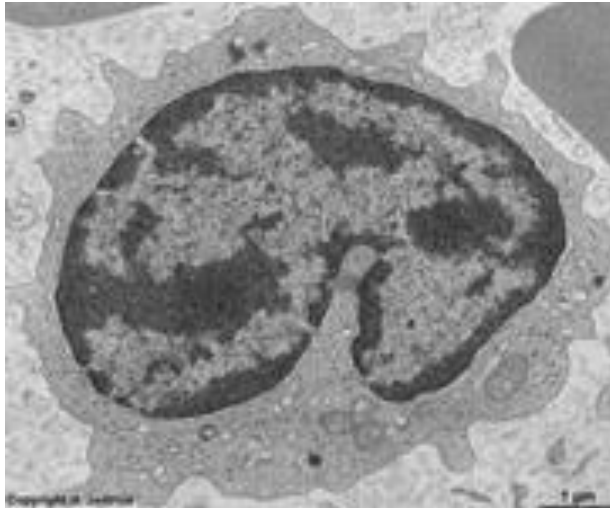


Fig. (7): Diagram of a monocyte by E.M.

• **BLOOD PLATELETS**, (Fig.8)

- minute, colorless, non-nucleated corpuscles found in the blood of all mammals. Their number ranges from 150,000-350,000 /c mm.

• **By L.M.**

- They appear in stained blood film thin biconvex fusiform disc 2-3 um diameter (smaller than RBCS) .
- They are having thin, pale blue peripheral zone called **hyalomere** and a thicker granular central region called the **granulomere**

By E.M.

- **The hyalomere** contains a circumferential bundle of microtubules for maintaining shape .
- **The granulomere** contains;
 - ✓ scattered glycogen granules, dense granules(ADP), lysosomes.
 - ✓ membrane bounded canaliculi that open to the surface (surface-connected canicular system): for discharge of secretory products upon activation of platelets.
 - ✓ Dense tubular system: not connected to the surface
 - ✓ mitochondria

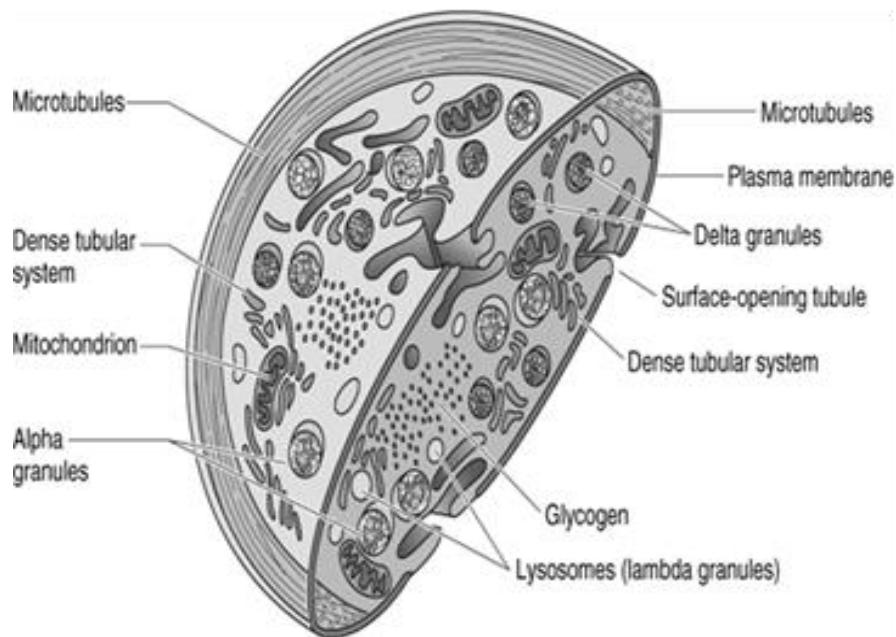


Fig. (8) : A diagram of a platelet by E.M.

• **Functions:**

1- adhering and initiating blood clotting upon injury or disruption of the endothelium.

2-Platelet derived growth factor: secreted on platelet activation and help in repair process.