

# BLOOD 2

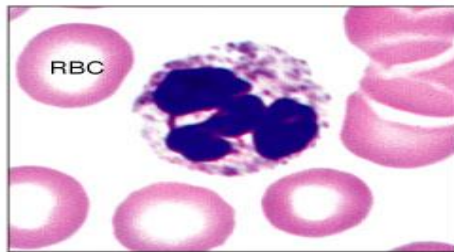
By

Heba Hassan Abd Elgawad

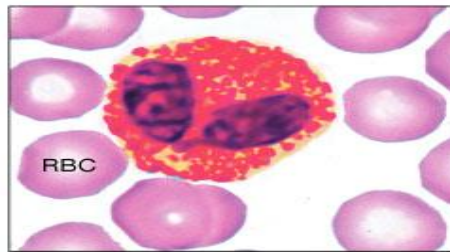
**Ass. Prof of Histology**

# Leukocytes(white blood cells or WBCs)

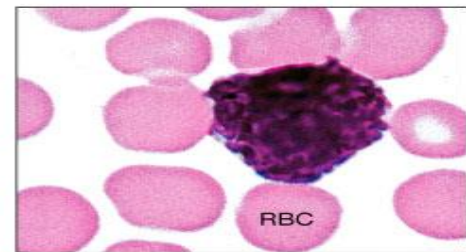
- Leukocytes are true cells with a nucleus and cytoplasm. They leave the blood and migrate to the tissues where they become functional and perform various activities related to immunity.
- **Total leukocytic count:**  
4,000 – 11,000 / cubic millimeter of blood.



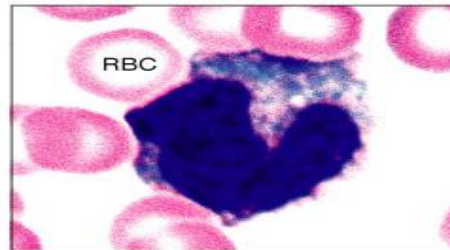
(a) Neutrophil



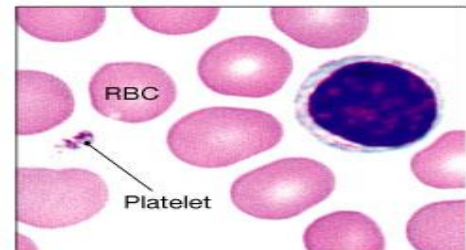
(b) Eosinophil



(c) Basophil



(d) Monocyte



(e) Lymphocyte

**Leukocytosis** is the increase in number of leukocytes above 11000 / cubic millimeter which is either:

**Physiological:** as during pregnancy, lactation, after muscular exercise and after cold baths.

**Pathological:** as in acute pyogenic infections (abscess, acute follicular tonsillitis and acute appendicitis).

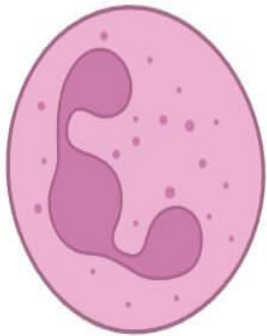
**Leucopenia** is the decrease in the number of WBCs below 4000/ cubic millimeter, it occurs in:

Influenza and typhoid fever.

Exposure to irradiation & X-ray.

# White Blood Cells (WBCs)

## Granulocytes



Neutrophil

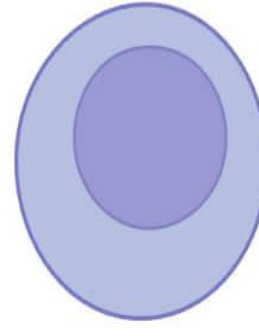


Eosinophil

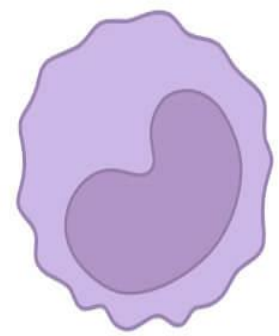


Basophil

## Agranulocytes



Lymphocyte



Monocyte



According to the type of cytoplasmic granules

# Classification

**Granular Leukocytes**

**Neutrophils**  
60-70%

**Eosinophis**  
1-4%

**Basophils**  
0- 1%

**Non Granular Leukocytes**

**Lymphocytes**  
20-25%

**Monocytes**  
3-8%

**Differential  
leucocytic count**

**According to the type of cytoplasmic granules and their nuclear morphology, leukocytes are divided into two groups:**

### **I- Granulocytes:**

- EM: Their cytoplasm is rich in fine granules .There are two types of granules:

- 1- The specific granules that bind neutral, basophilic or acidophilic components of the dye mixture and have specific functions

- 2- The non-specific (azurophilic) granules: (lysosomes).

- Granulocytes have nuclei with 2 or more lobes. Life span is few days and dies by apoptosis (programmed cell death) in the connective tissues.

**II-Agranulocytes** do not have specific granules, but they contain azurophilic granules (lysosomes). the nucleus is spherical or indented but not lobulated.

- Both types are rather spherical while suspended in blood plasma, but they become amoeboid and motile after leaving the blood vessels and invading the tissues.

**Diapedesis:** the leukocytes send extensions through the openings between the endothelial cells, migrate out of the venules into the surrounding tissue space to the site of injury or invasion.

**Chemotaxis** (movement in response to chemicals): The attraction of leucocytes by chemical mediators which causes leukocytes to rapidly accumulate where their defensive actions are needed.



Blood vessel

Endothelial cell

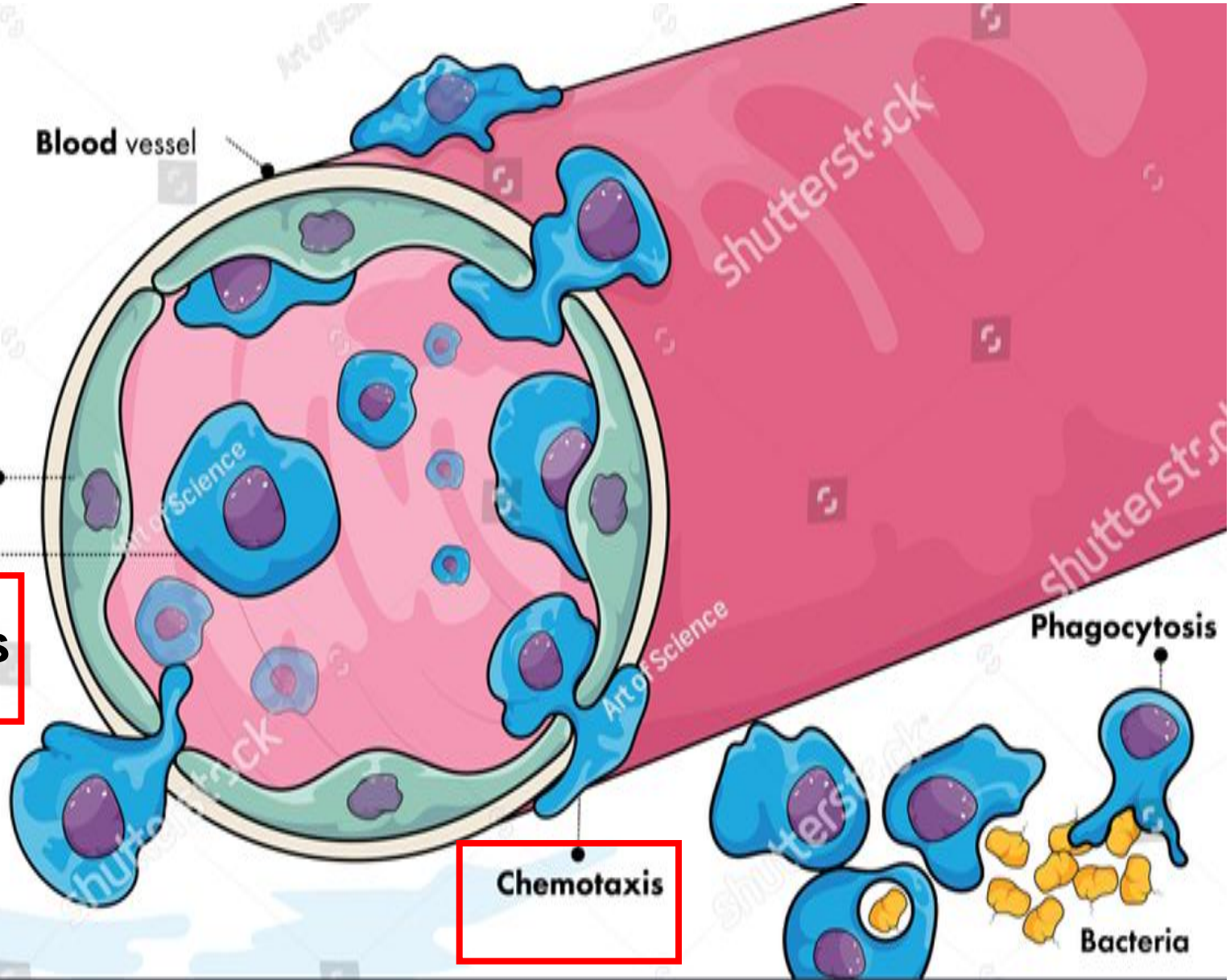
Neutrophils

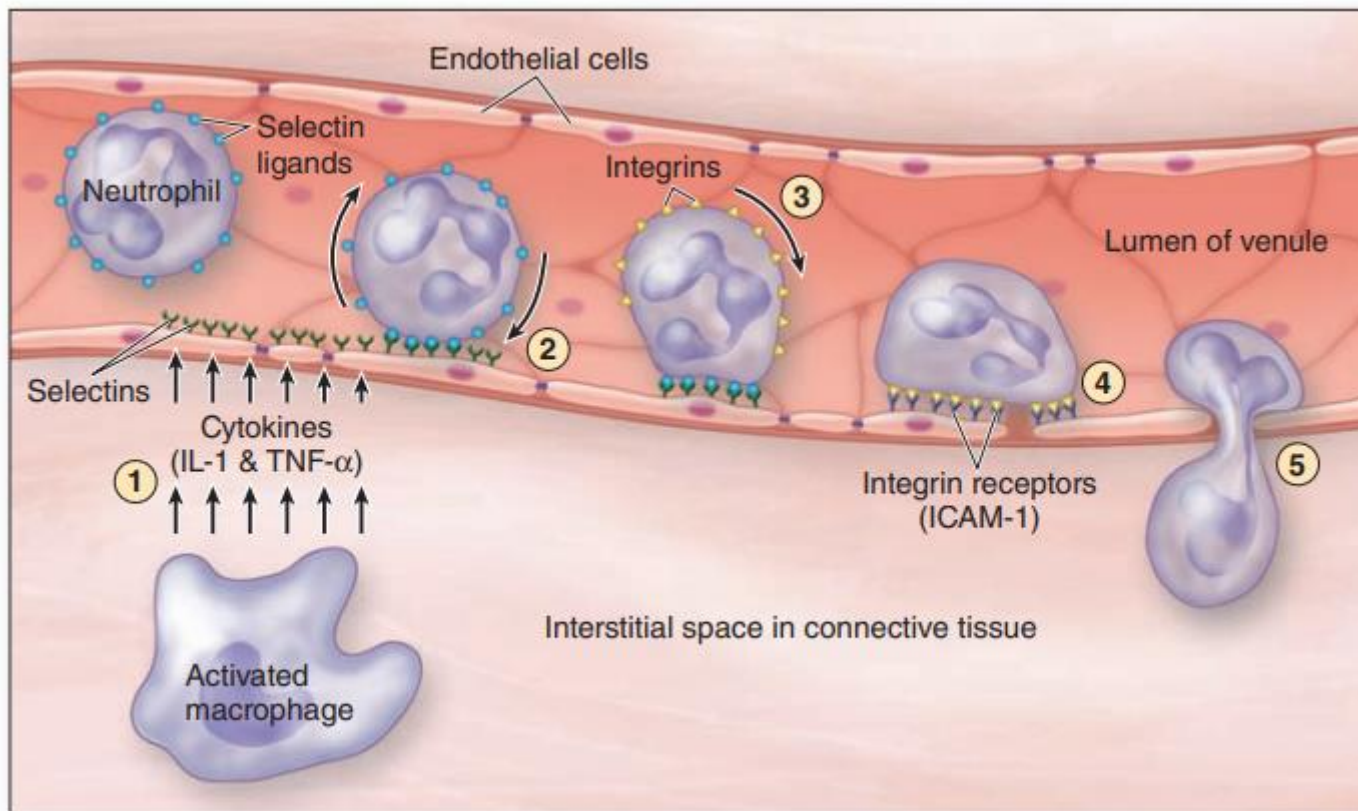
Diapedesis

Chemotaxis

Phagocytosis

Bacteria





- At such sites, factors termed cytokines are released from various sources and these trigger loosening of intercellular junctions in the endothelial cells. Simultaneously, the cell adhesion protein P-selectin appears on these cells' luminal surfaces with exocytosis of Weibel-Palade bodies. Neutrophils and other leukocytes have on their surfaces ligands for P-selectin, and their interactions cause cells flowing through the venules to slow down. Other cytokines stimulate slowly rolling leukocytes to express integrins that produce firm attachment to the endothelium → Diapedesis

# Neutrophils (Polymorphs, polymorphnuclear leukocyte)

- **Shape:** They are rounded cells
- **Surface:** Pseudopodia
- **Size :** 10-12 microns.
- **Life Span:** 3-5 days

-**Neutrophilia** means increase in the percentage of neutrophils above normal (as in acute pyogenic infections).

-**Neutropenia** means decrease in the percentage of neutrophils below normal (as in viral infections).

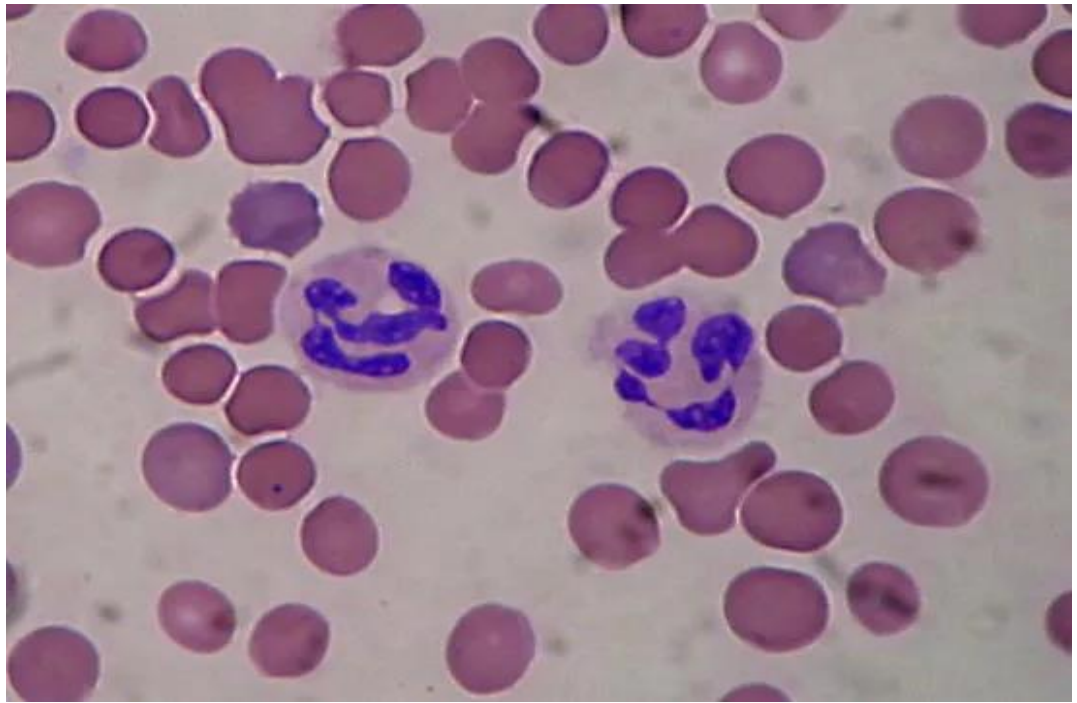


# Neutrophils

- Structure:

- The nucleus:

- single,
  - segmented into many lobes (usually 3) connected to each other by chromatin threads
  - In females, the inactive X chromosome may appear as a drumstick-like appendage on one of the lobes of the nucleus



**Cytoplasm:** contains two types of granules:

- a. Specific granules which are small & numerous stained faint pink and cannot be seen with LM.
  - EM: These granules are membranous vesicles containing alkaline phosphatase and bactericidal enzymes.
  - various ECM-degrading enzymes such as collagenases.
  - chemokines that attract other leukocytes and cytokines that direct activities of other cells
  - Important lipid mediators of inflammation are also released from neutrophils.



# Cytoplasm:

b. Non-specific (Azurophilic) granules are large, less numerous, stained purple and can be seen with LM.

- EM: These granules are primary lysosomes containing hydrolytic enzymes.
- **Myeloperoxidase (MPO)**, which generates hypochlorite and other agents toxic to bacteria
- **Lysozyme**, which degrades components of bacterial cell walls
- **Defensins**, small cysteine-rich proteins that bind and disrupt the cell membranes of many types of bacteria and other microorganisms.

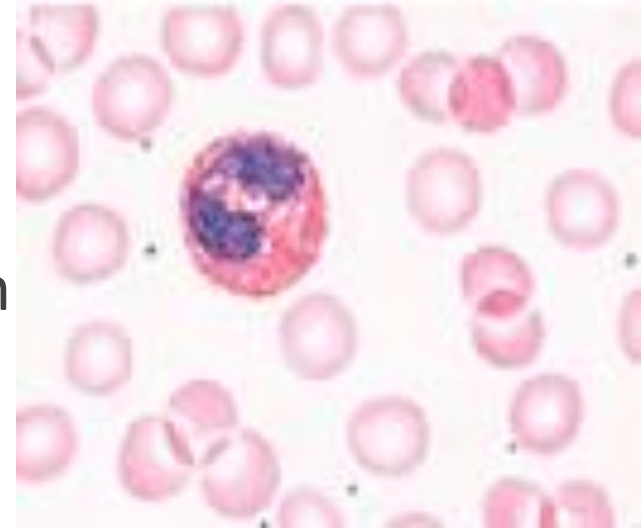
- E.M: The cytoplasm also contains glycogen, small Golgi body, few mitochondria and little endoplasmic reticulum.

- **Function:**

- 1- Phagocytosis & digestion of micro-organisms especially bacteria by the specific and non specific (azurophilic) granules.
- 2- Release of macrophage chemotactic factor that stimulate attraction of macrophages at the site of inflammation.
- 3- Release of fibroblast chemotactic factor to stimulate fibroblasts to form new collagen leading to healing.
- 4- Dead neutrophils, bacteria, semidigested material and tissue fluid form a viscous usually yellow collection of fluid called pus

# Eosinophils

- **Shape:** They are rounded cells
- **Size :** with diameter ranging from 10-12 m
- **Life Span:** 8-12 days
- **Structure:**



**The nucleus:** Single, **bilobed** connected by thin chromatin thread (horse-shoe shaped).

## **Abnormal count:**

Eosinophilia: in allergic and parasitic diseases.

Eosinopenia: after cortisone treatment.

**Cytoplasm:** - Cytoplasm contains:

a- Specific granules: Large elongated specific granules with central crystalline dense core formed of protein called **major basic protein (MBP)**. This core is surrounded by less dense material consists of some enzymes e.g. arylsulfatase and histaminase.

b- Nonspecific granules are lysosomes containing hydrolytic enzymes.

c- Glycogen, and poorly developed endoplasmic reticulum, mitochondria and Golgi body are present.



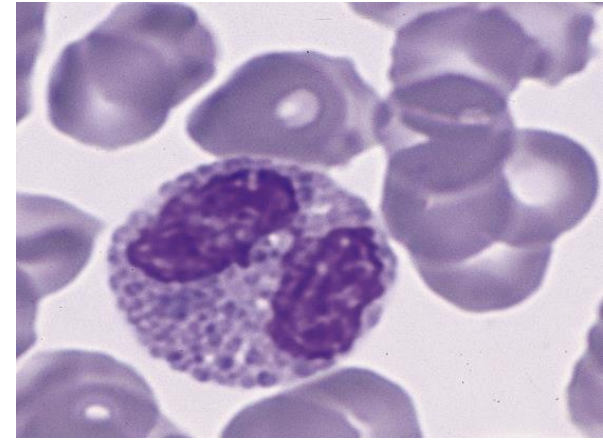
# Eosinophils

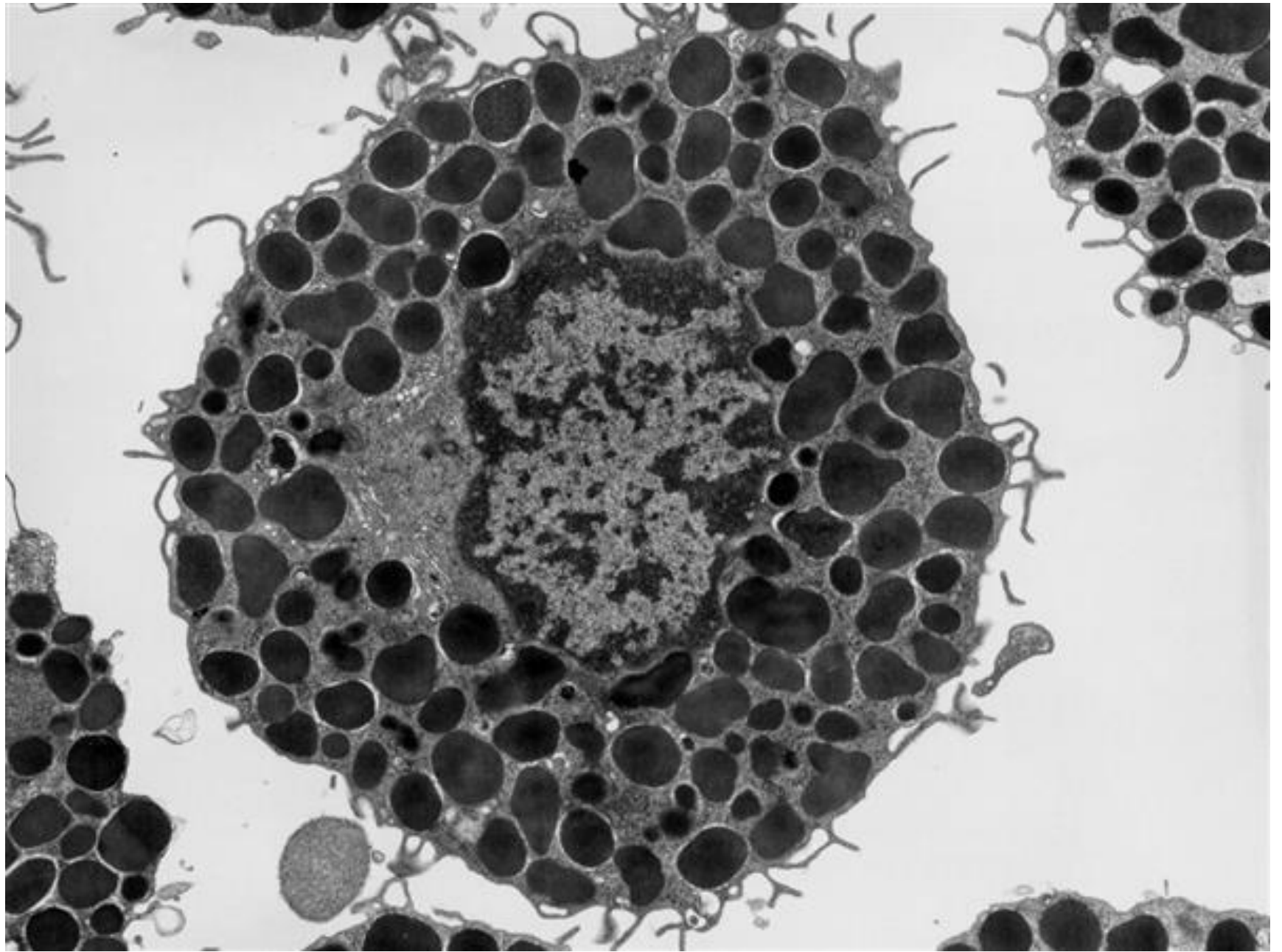
## Function:

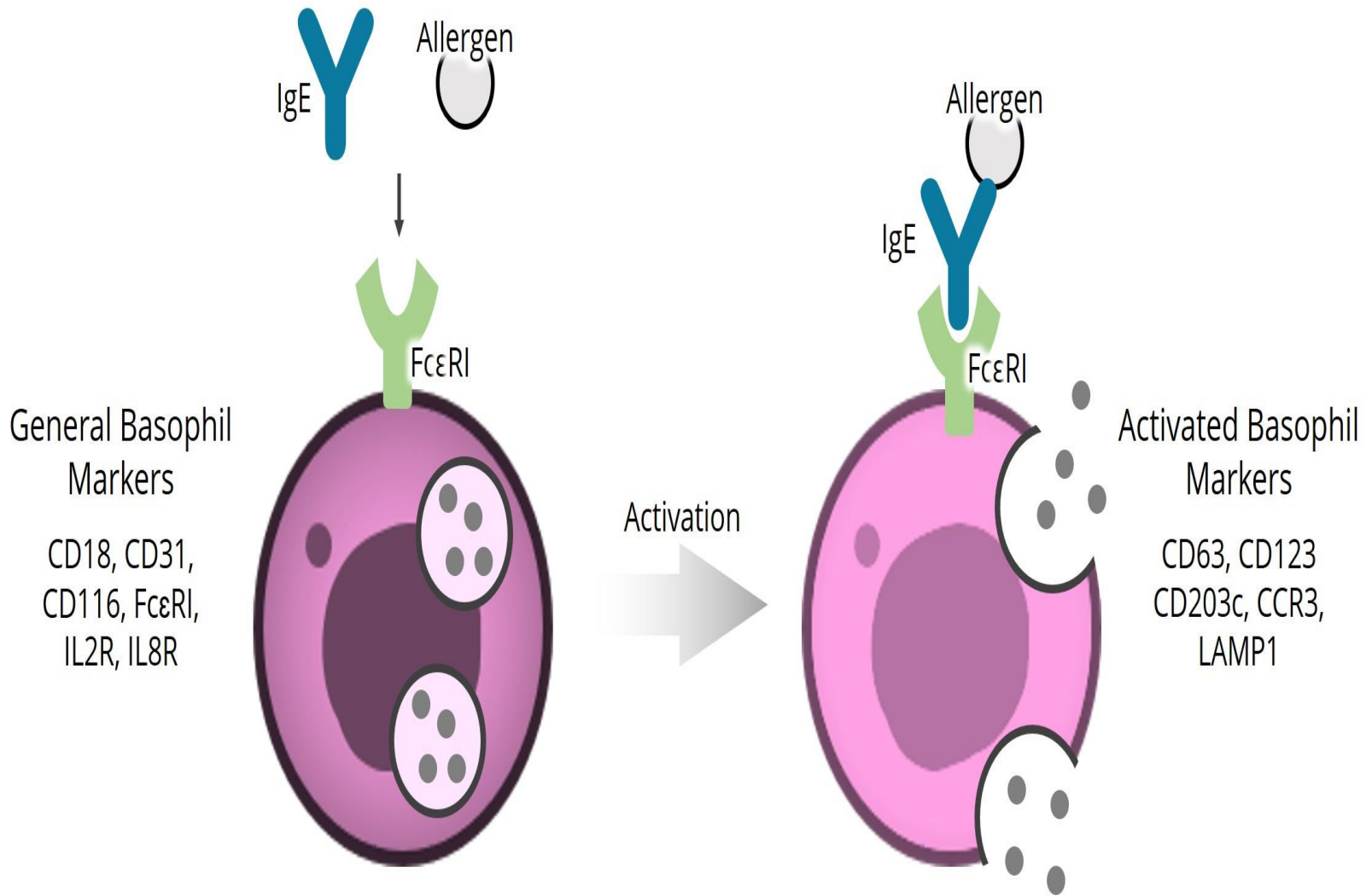
- They phagocytose antigen- antibody complexes.
- They are attracted to the sites of allergic reactions by eosinophil chemotactic factor which is released by mast cells to reduce their effects by releasing antihistamine (histaminase).
- Play a role in killing parasitic worms by major basic protein

# Basophils

- **Shape:** They are rounded cells
- **Size :** with diameter ranging from 10-12 m
- **Life Span:** 12-15 days
- **Structure:**
- **Nucleus:** The nucleus is large and is often bent into a U or S shaped.
- **Cytoplasm :**
  - a. Specific granules: they are large, basophilic and obscure the nucleus. They are metachromatically stained by toluidine blue and contain heparin & histamine, like mast cells.
  - b. Nonspecific granules: they are lysosomes







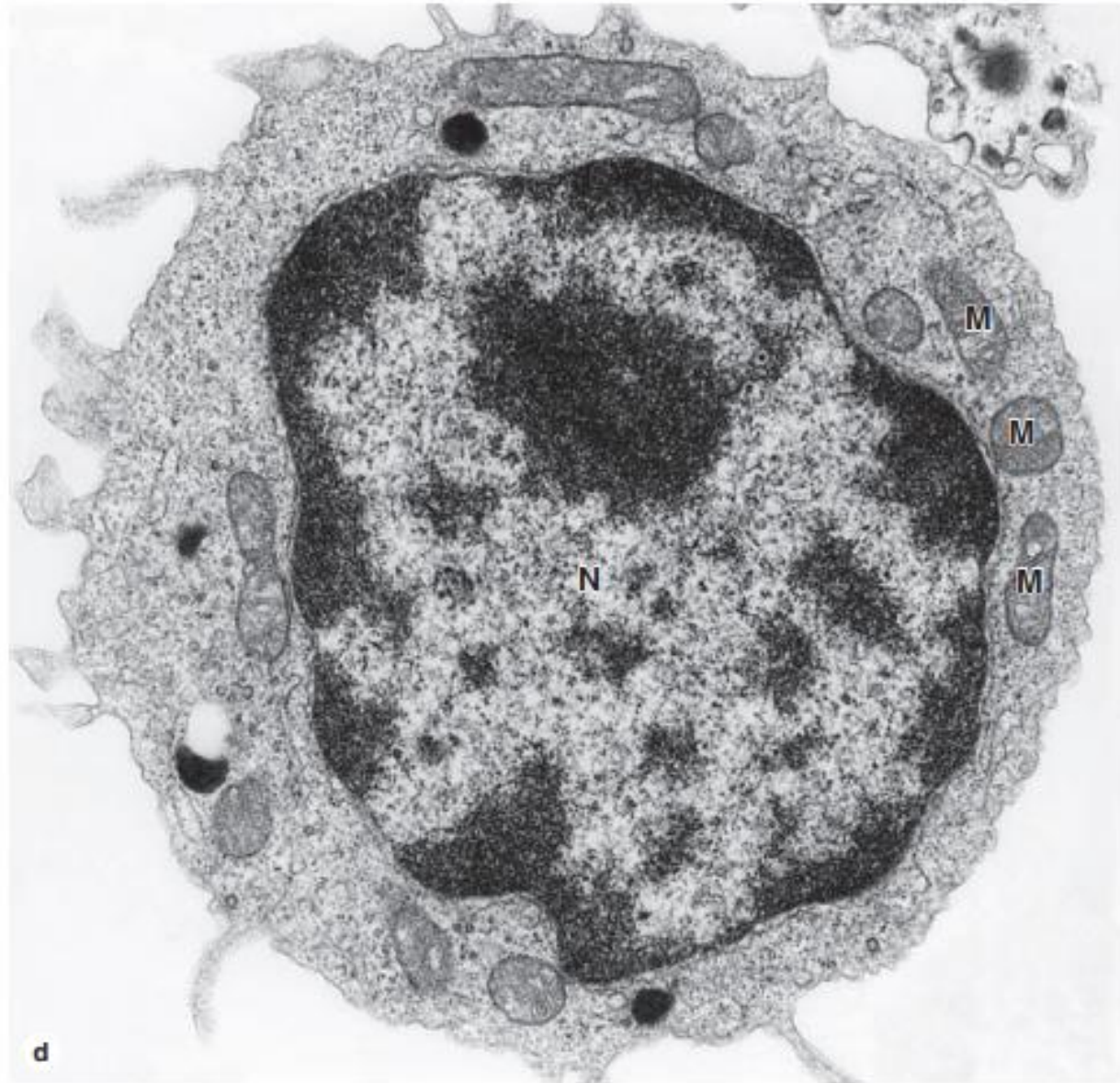
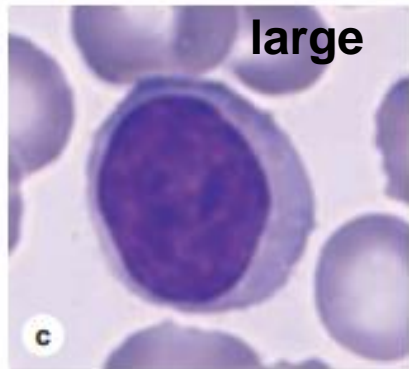
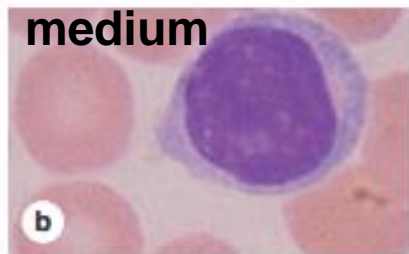
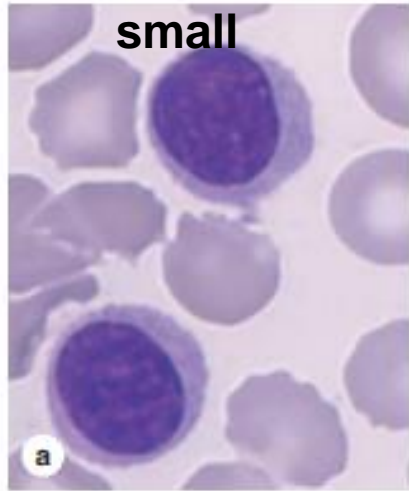
c- Varying amounts of glycogen, small Golgi apparatus, a few mitochondria and poorly – developed endoplasmic reticulum.

The cell surface has receptors for the plasma IgE, which when come in contact with the antigen (in the blood); they form antigen-antibody complex resulting in degranulation of the basophils and release of its mediators.

▪ **Functions:**

- Secretion of eosinophil chemotactic factor.
- Secretion of heparin (anticoagulant) and histamine (initiates allergic reactions).
- enzyme phospholipase A that catalyzes an initial step in producing lipid-derived proinflammatory factors called leukotrienes.
- by migrating into connective tissues, basophils appear to supplement the functions of mast cells,
- **Basophilia means increase of basophils above 1% as in liver cirrhosis.**

# Lymphocytes



# Lymphocytes

- There are different types of lymphocytes; large, medium and small lymphocytes. They are present in the C.T., lymph nodes, spleen, thymus, tonsils and tissue fluids.
- Lymphocytes are the only type of leukocytes that return back from the tissue to the blood.

**Large lymphocytes:** They are believed to be small lymphocytes activated by the specific antigens.

- Diameter: 12-15  $\mu\text{m}$
- Percentage: 5-10% of circulating WBCs.
- Structure:

-**Nucleus:** is large & lightly stained (active chromatin) with apparent nucleolus.

-**Cytoplasm:** is abundant, more basophilic (containing ribosomes) & non-granular. It also contains a few azurophilic granules.

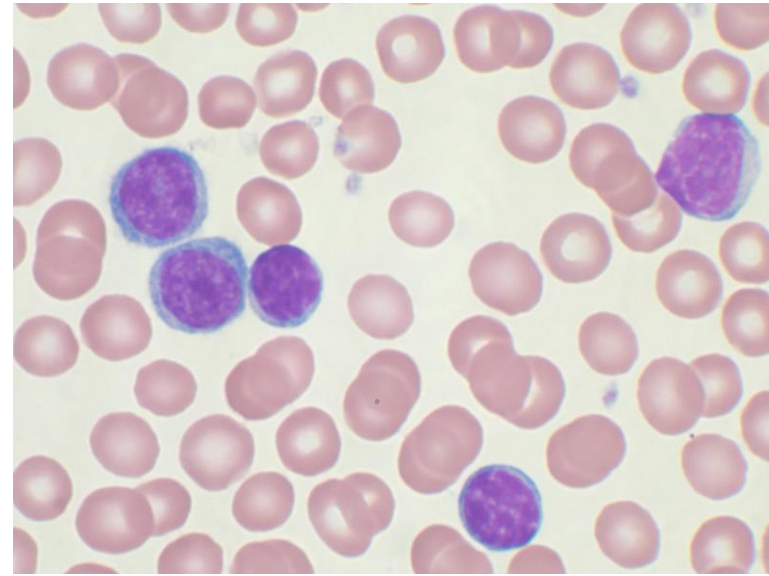
**Small lymphocytes:** They are the commonest.

- Diameter: 7-9  $\mu\text{m}$
- Percentage: 15-20 % of circulating WBCs.
- Structure:

-They are spherical in shape.

- **Nucleus:** is large, rounded & darkly stained (condensed chromatin) with little indentation at one side. -

- **Cytoplasm:** is scanty, and appears as a narrow rim around the nucleus. It is lightly basophilic and non-granular containing a few azurophilic granules, mitochondria, a small Golgi complex and a pair of centrioles and abundant ribosomes.



- There are two types of small lymphocytes:

**B-lymphocytes:** - They constitute 25 % of circulating small lymphocytes.

- B- Lymphocytes are produced in bone marrow in man.

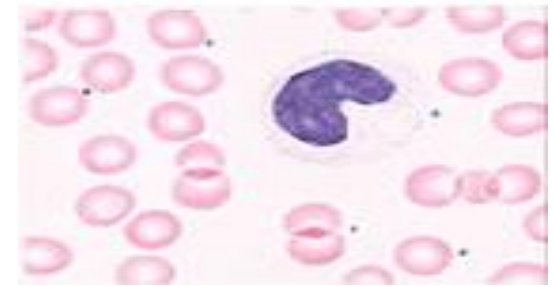
**Function:** They are responsible for humoral immunity.

B-lymphocytes when stimulated by specific antigen, some of B-lymphocytes differentiate into plasma cells to produce antibodies. Others generate B-memory cells, which react rapidly to a second exposure to the same antigen

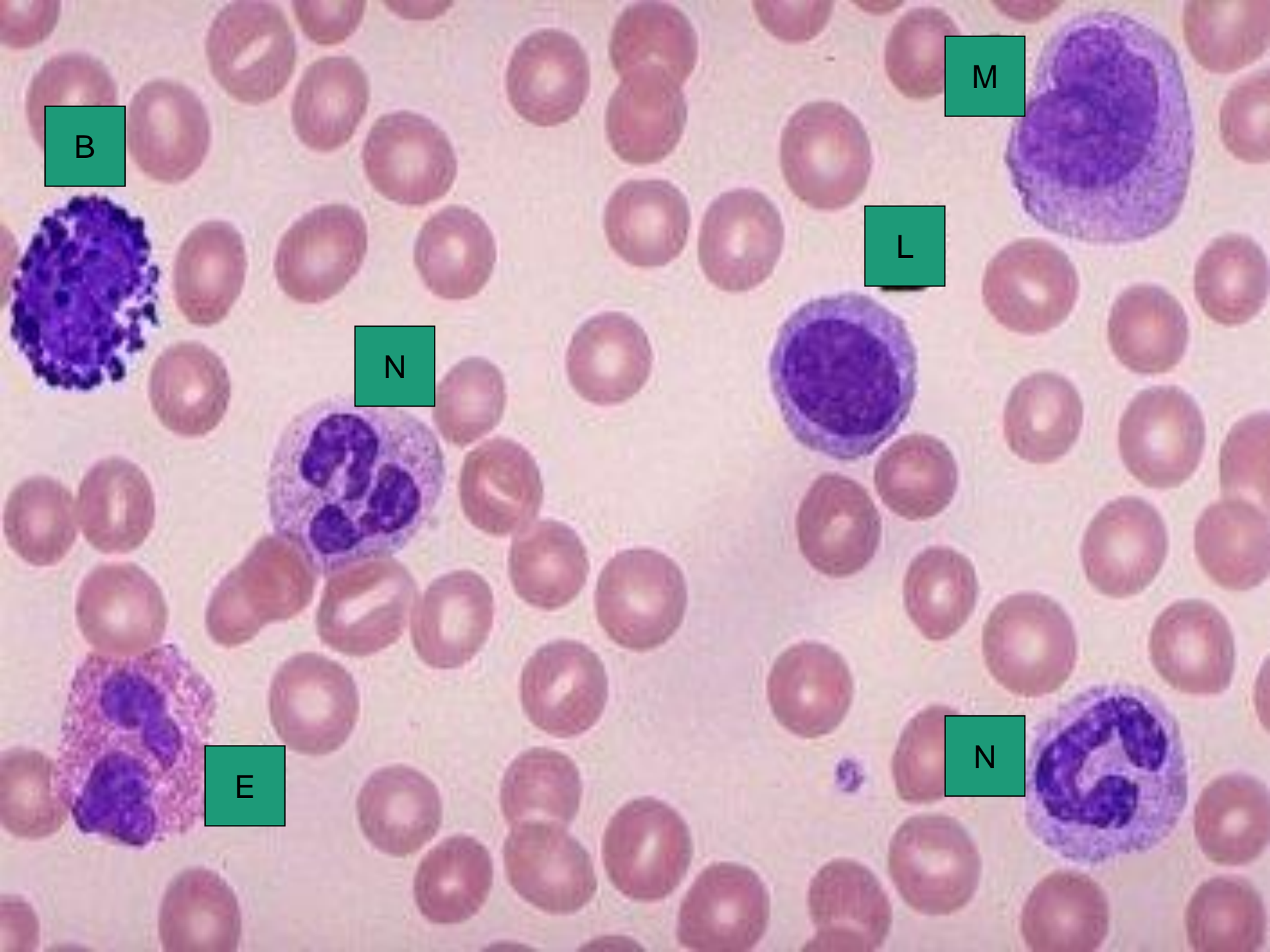
**T- lymphocytes:**

- They originate in the bone marrow and migrate to the thymus, where they proliferate and carried by the blood to other lymphoid tissue.
- Percentage: 65-75 % of the circulating lymphocytes.
- They are responsible for cellular immunity.

# Monocytes



- **Shape:** They are rounded cells
- **Size:** 12-20 microns in diameter.
- **Life Span:** Monocytes circulate in blood about three days after which they leave blood to the connective tissues, where they differentiate into macrophages.
- **Structure:**
  - The nucleus:** oval in shape with deep indentation. Sometimes, it takes the kidney shape. Its chromatin is less condensed than that of lymphocytes
  - Cytoplasm:** The cytoplasm is abundant and pale blue. contains very fine azurophilic granules (lysosomes), well developed Golgi.
- **Function and abnormal count:** In the connective tissue they change to macrophages which are highly phagocytic cells. They increase in number in malaria, typhoid, and monocytic leukemia.



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# Thank You

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