BLOOD 2

By

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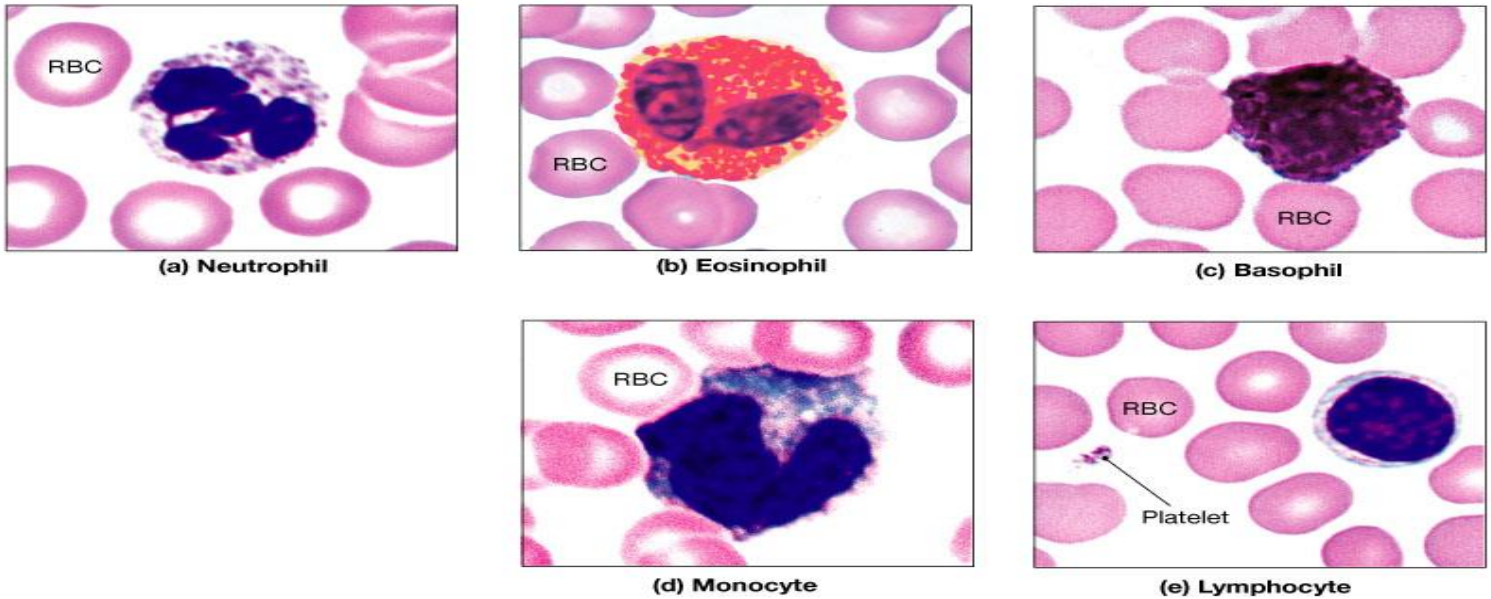
Leukocytes(white blood cells or WBCs)

- 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.



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.

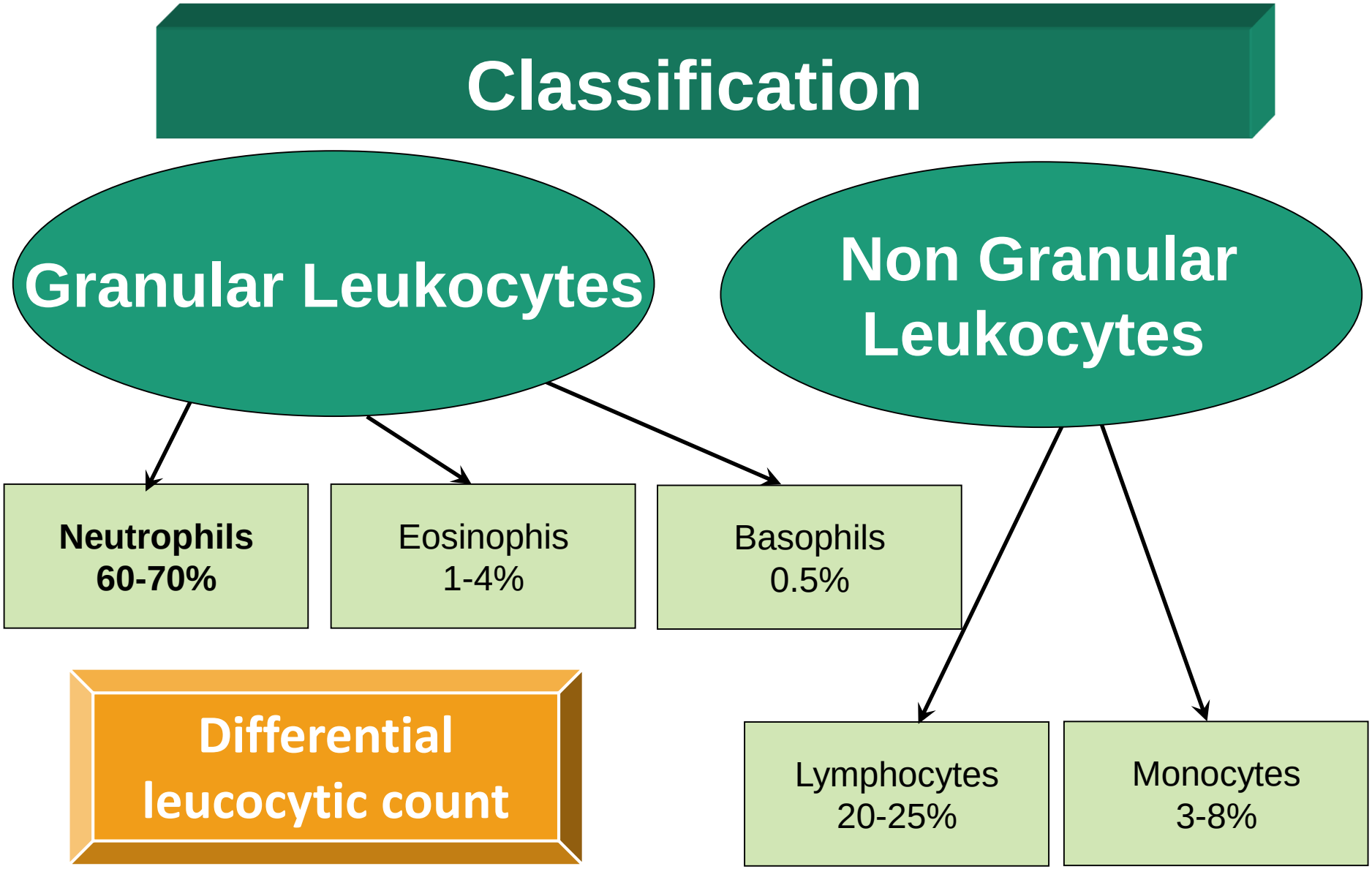
Pathological: as in acute pyogenic infections (abscess, acute follicular tonsillitis and acute appendicitis).

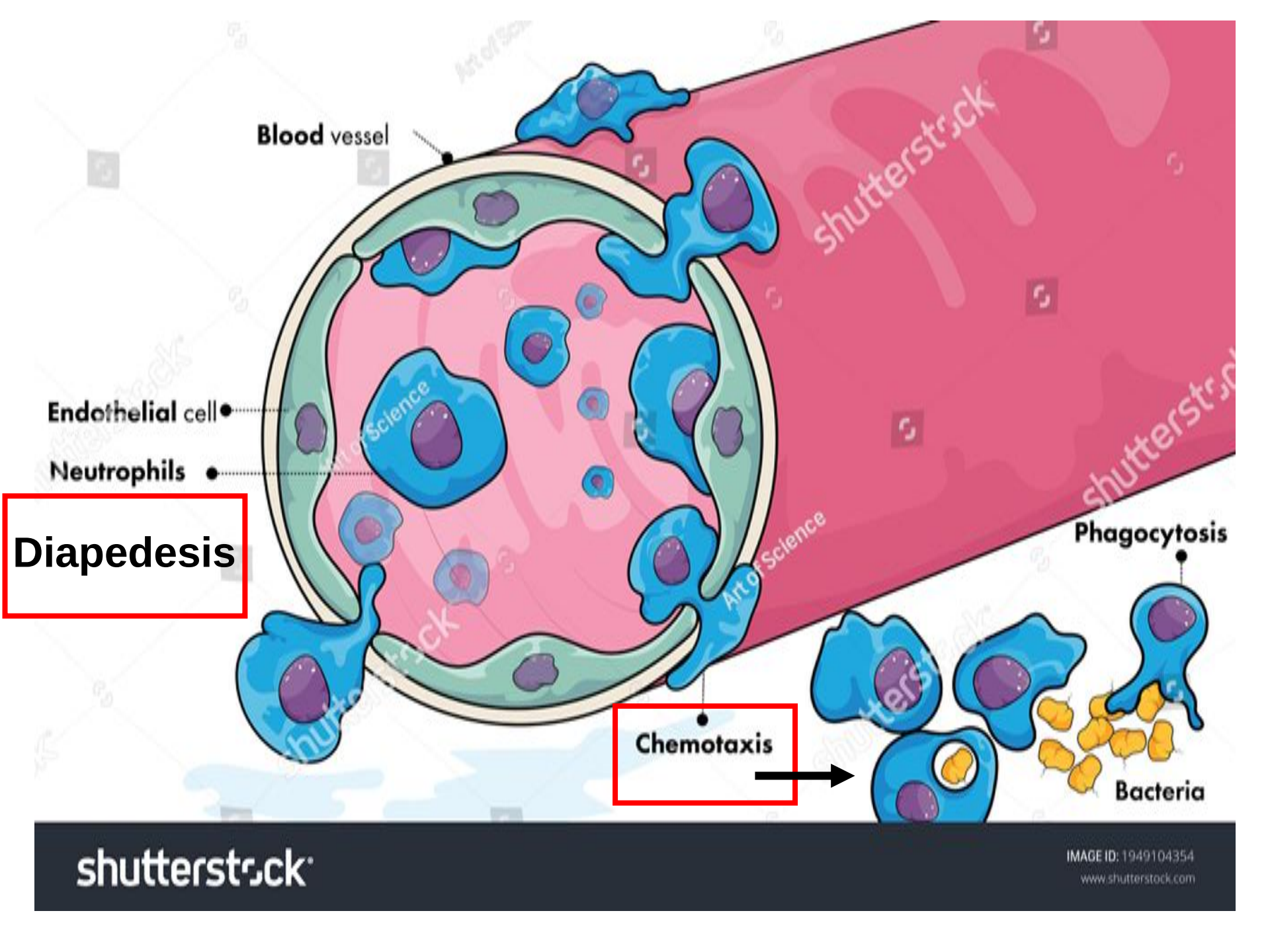
Leucopenia is the decrease in the number of WBCs below 4000/ cubic millimeter, it occurs in:

Influenza and typhoid fever.

Exposure to irradiation & X-ray.

According to the type of cytoplasmic granules




Blood vessel
Endothelial cell
Neutrophils
Diapedesis
Chemotaxis
Phagocytosis
Bacteria
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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: The attraction of leucocytes by chemical mediators which causes leukocytes to rapidly accumulate where their defensive actions are needed.

I- Granulocytes:

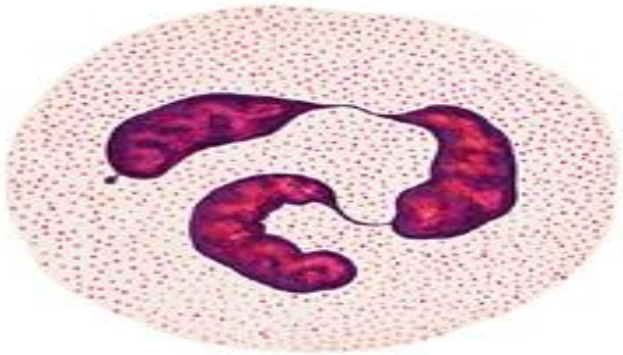
- EM: Their cytoplasm is rich in fine granules .There are two types of granules:

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

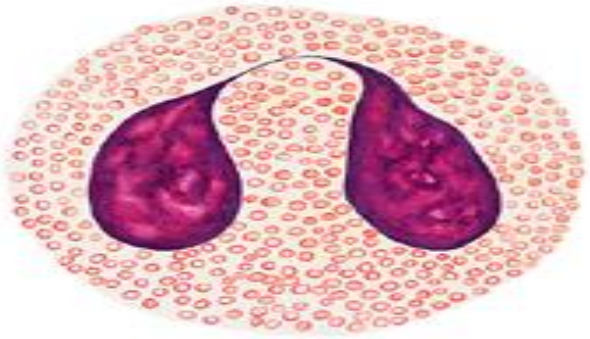
2- The non-specific (azurophillic) granules: (lysosomes).

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

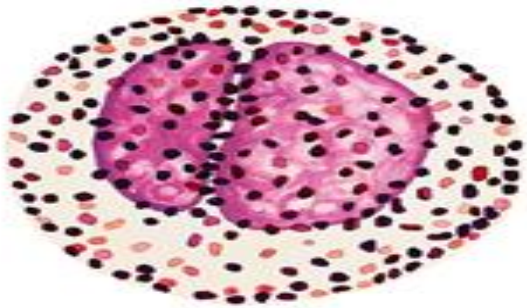
II-Agranulocytes do not have specific granules, but they contain azurophilic granules (lysosomes).



Neutrophilic granulocyte



Eosinophilic granulocyte



Basophilic granulocyte

Lymphocyte

Monocyte

Monocyte

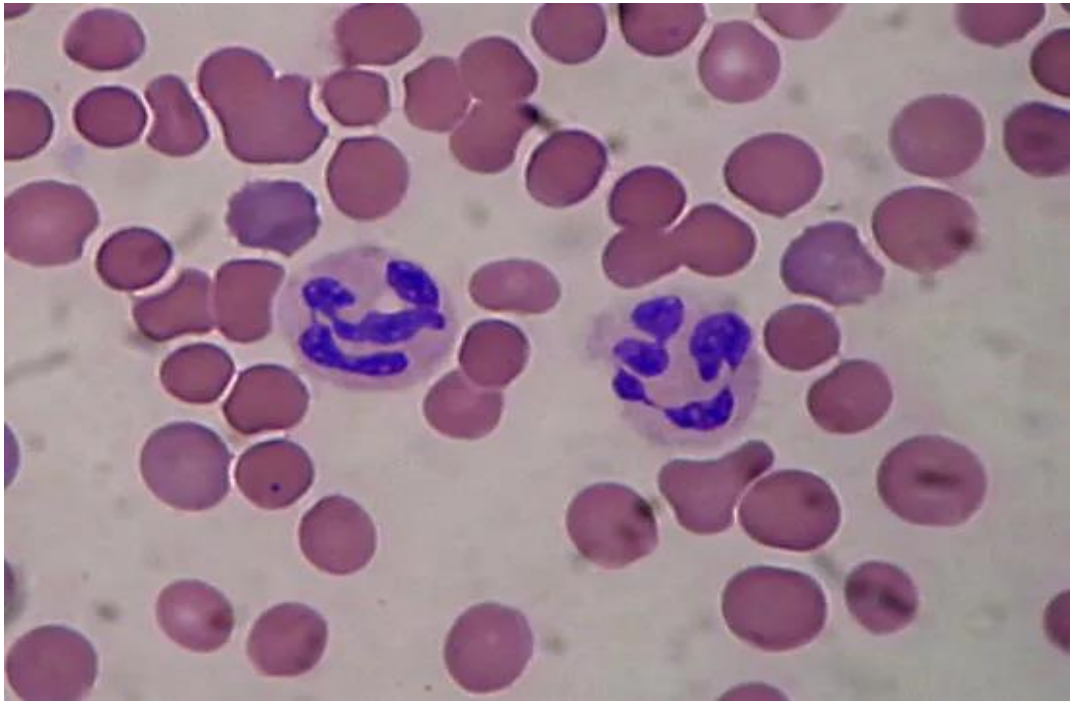
Neutrophils (Polymorphs, polymorphnuclear leukocyte)

- **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 (Barr body) 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.

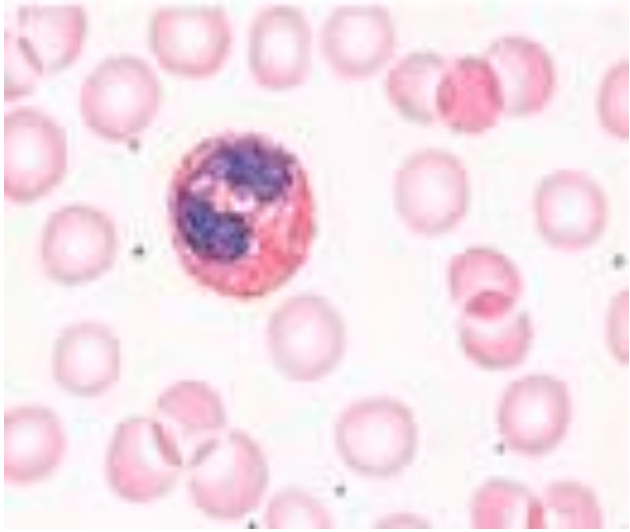
b. **Non-specific** (Azurophillic) granules are large, less numerous, stained purple and can be seen with LM.

- EM: These granules are primary lysosomes containing hydrolytic enzymes.

- 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 (azurophillic) 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**:

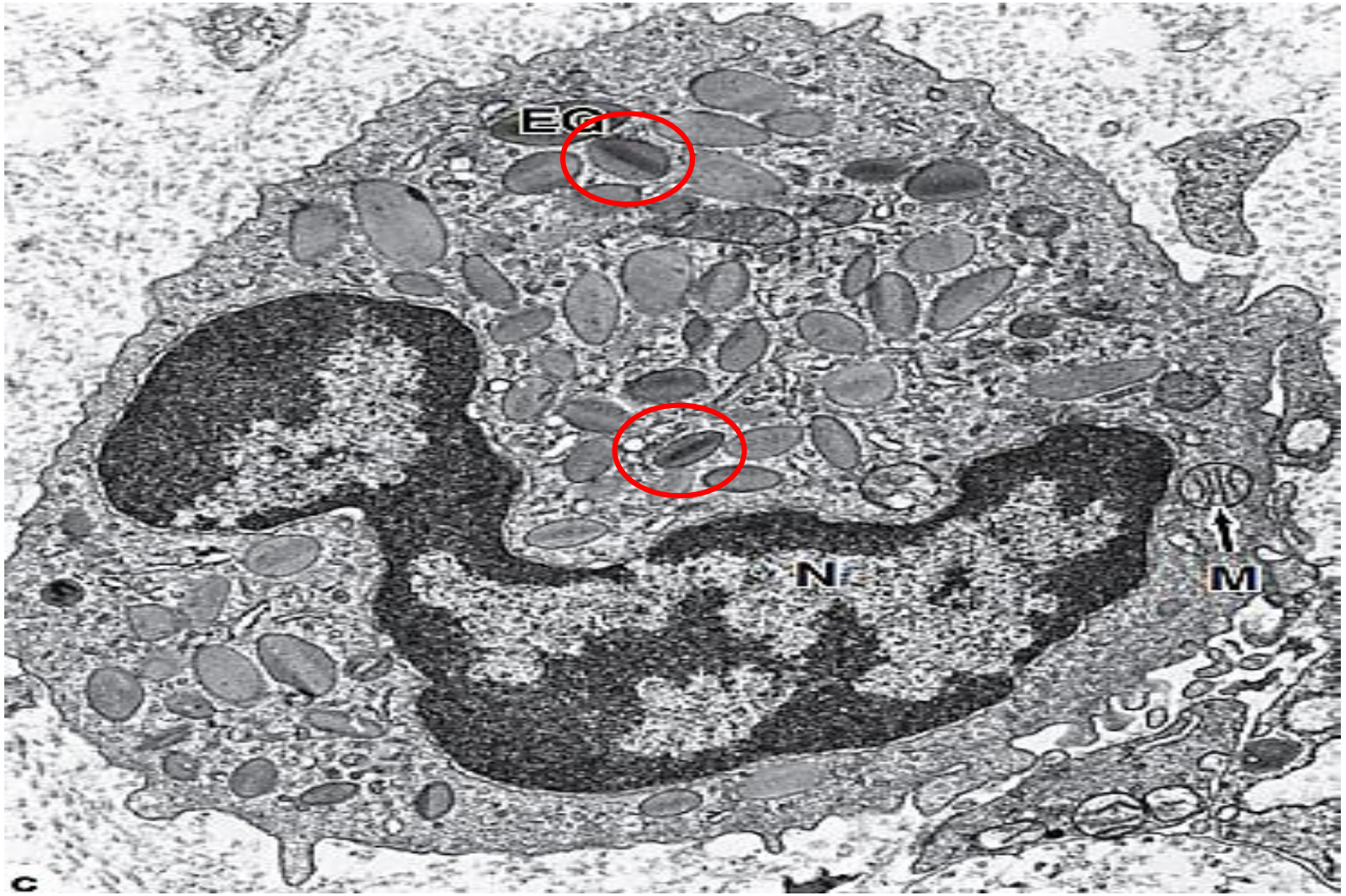
The nucleus: Single, bilobed connected by thin chromatin thread (horse-shoe shaped).

Abnormal count:

Eosinophilia: in allergic and parasitic diseases.

Eosinopenia: after cortisone treatment.

Eosinophils



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.

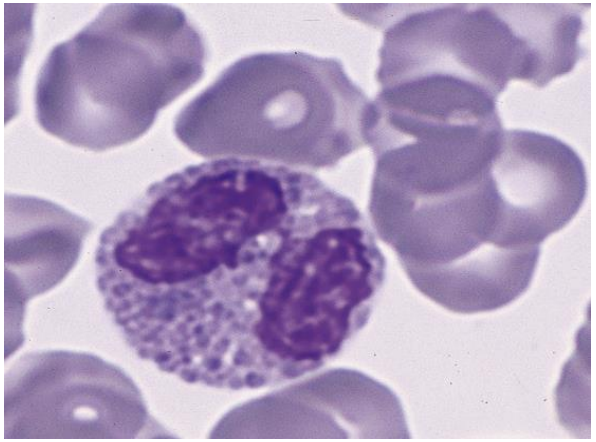
c-Glycogen, and poorly developed endoplasmic reticulum, mitochondria and Golgi body are present.

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

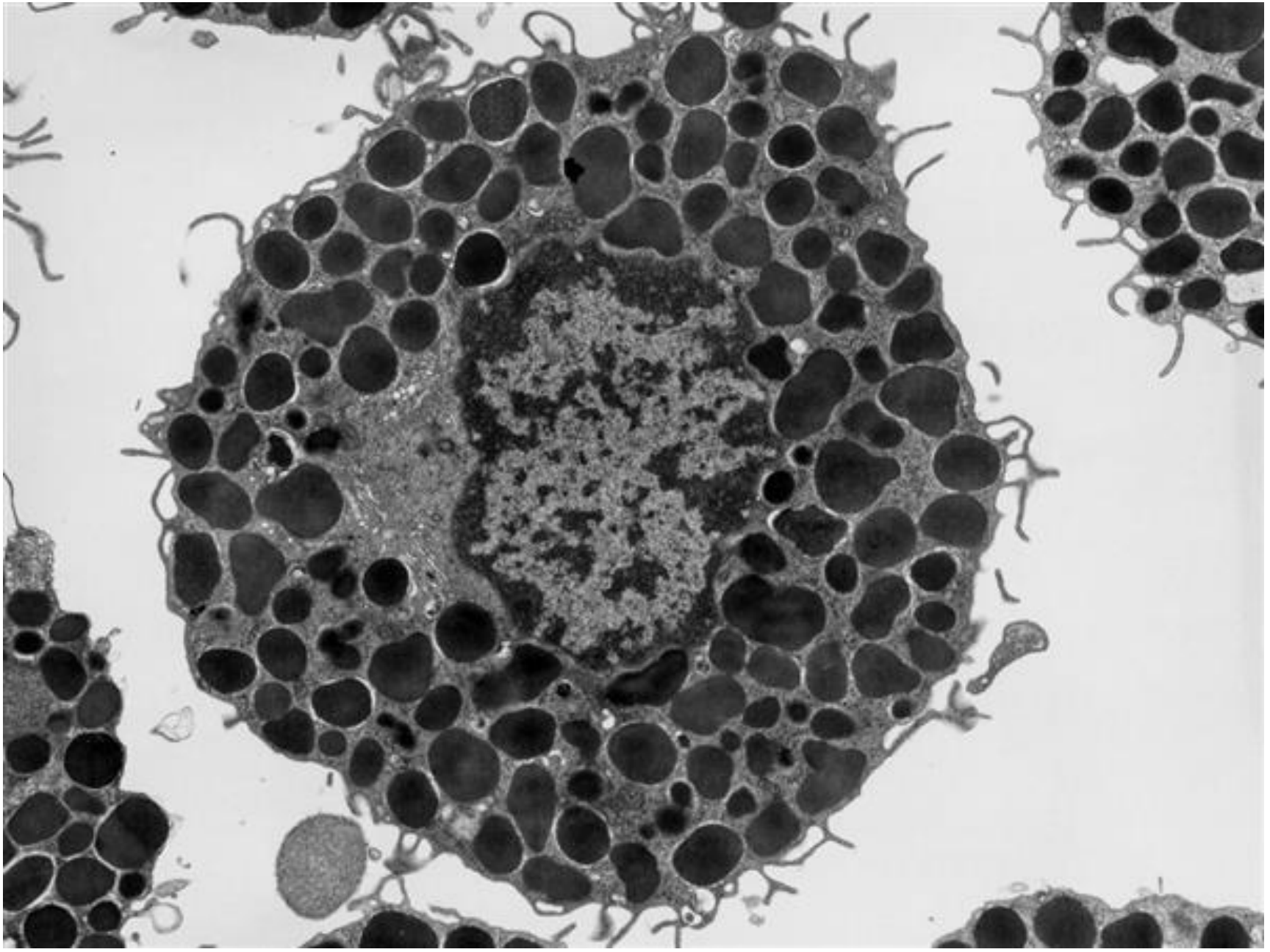
Basophils

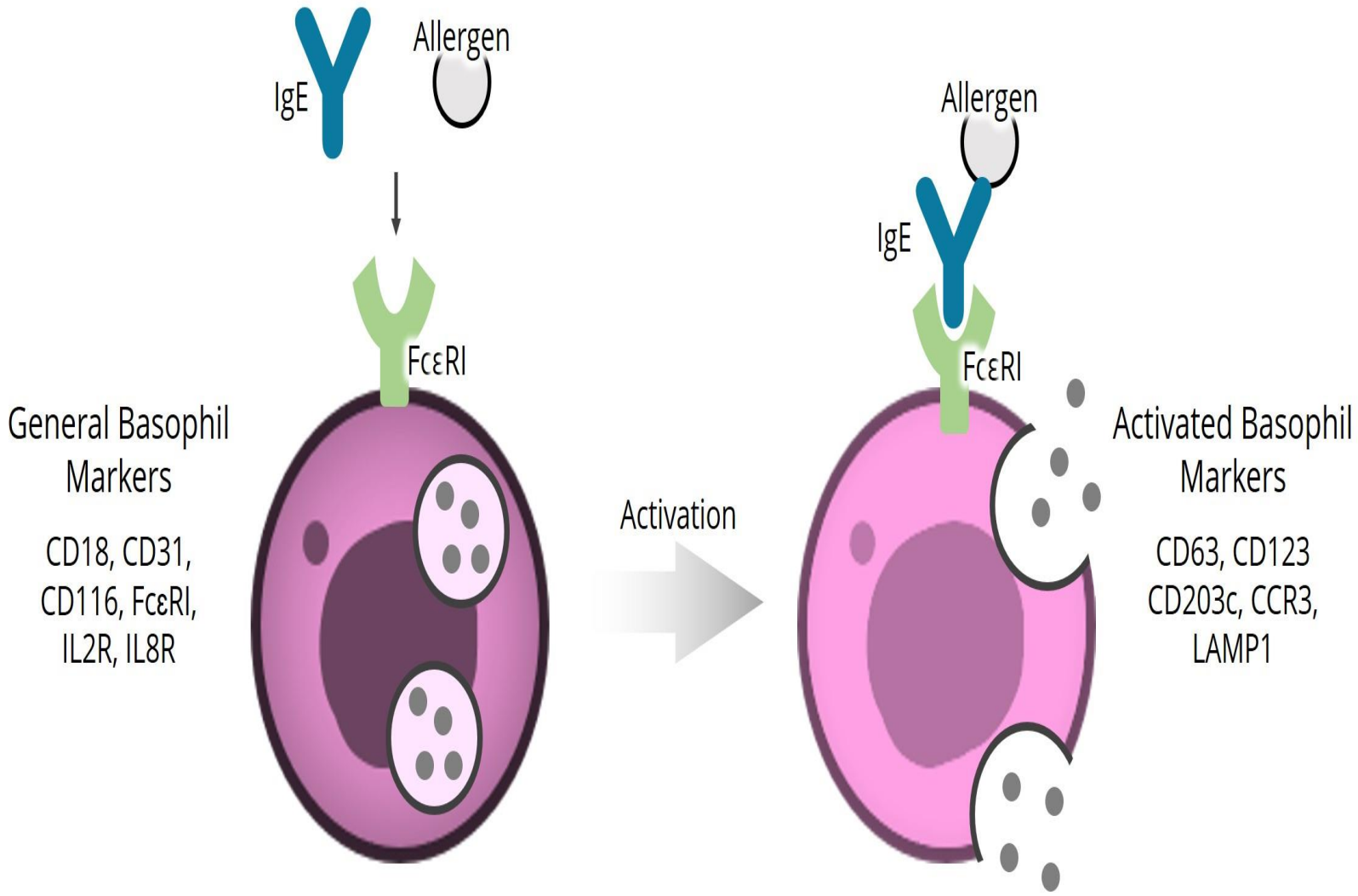


- **Shape:** They are rounded cells
- **Size :** with diameter ranging from 10-12 m
- **Life Span:** 12-15 days
- **Structure:**
- **Nucleus:** The nucleus is large and is often bent into a U or S shaped.
- **Cytoplasm** :

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



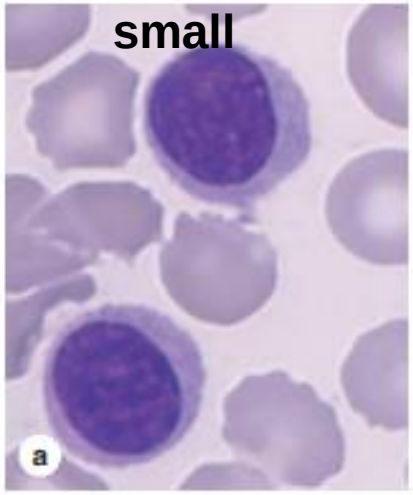

IgE
Allergen
FcεRI
General Basophil Markers
CD18, CD31, CD116, FcεRI, IL2R, IL8R
Activation
Allergen
IgE
FcεRI
Activated Basophil Markers
CD63, CD123 CD203c, CCR3, LAMP1

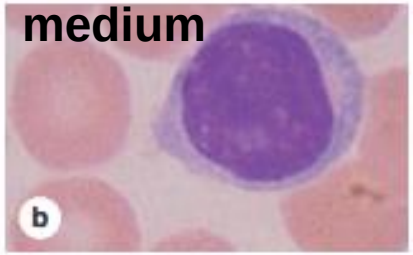
c- Varying amounts of glycogen, small Golgi apparatus, a few mitochondria and poorly – developed endoplasmic reticulum.

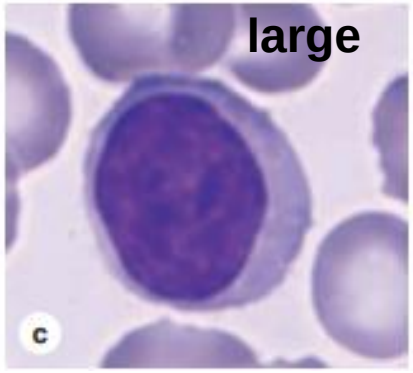
The cell surface has receptors for the plasma IgE, which when come in contact with the antigen (in the blood); they form antigen-antibody complex resulting in degranulation of the basophils and release of its mediators.

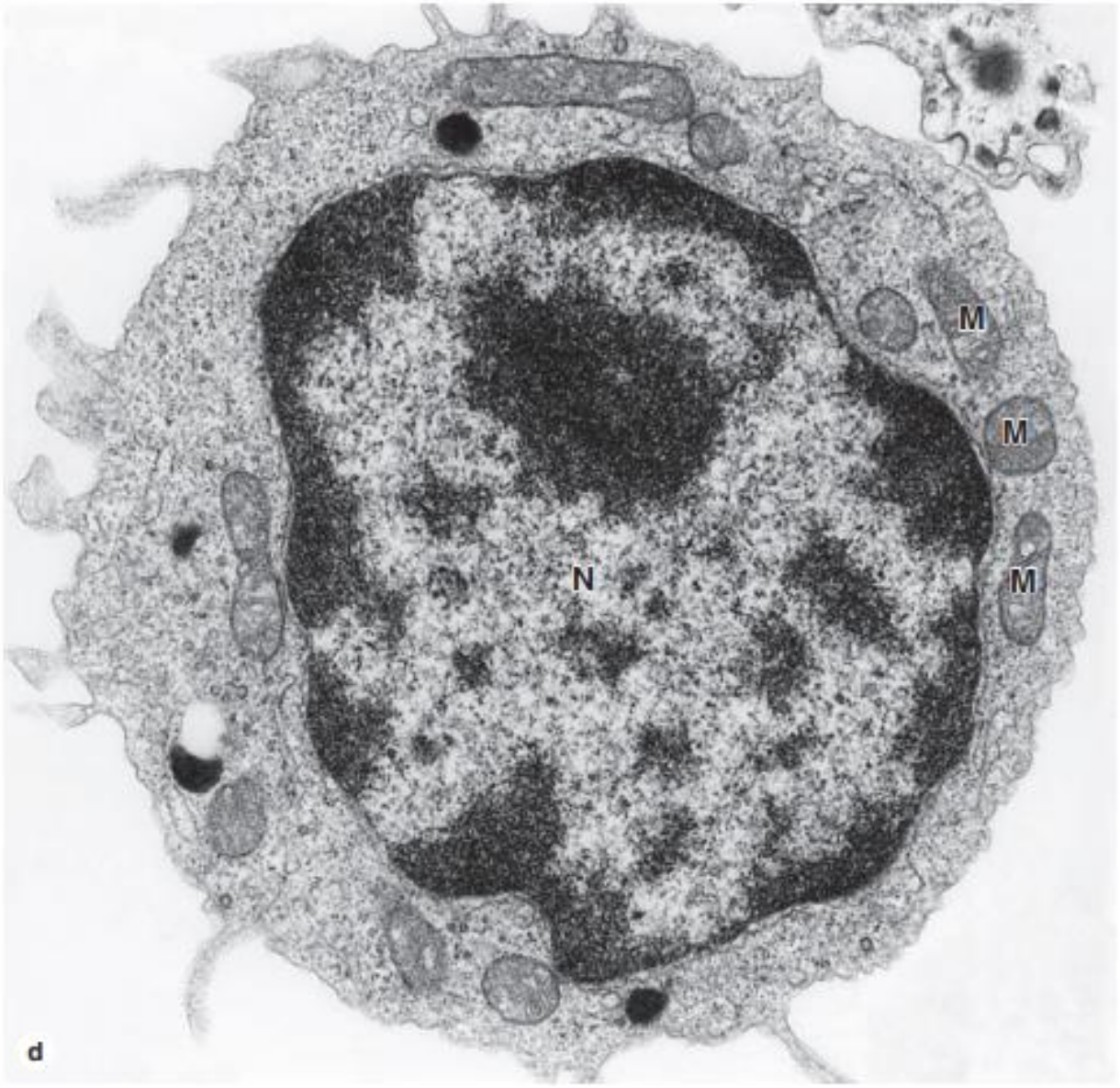
- **Functions:**
  - Secretion of eosinophil chemotactic factor.
  - Secretion of heparin (anticoagulant).
  - Secretion of histamine (initiates allergic reactions).
  - Basophilia means increase of basophils above 1% as in liver cirrhosis.

Lymphocytes









Lymphocytes

- There are different types of lymphocytes; large, medium and small lymphocytes. They are also 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.

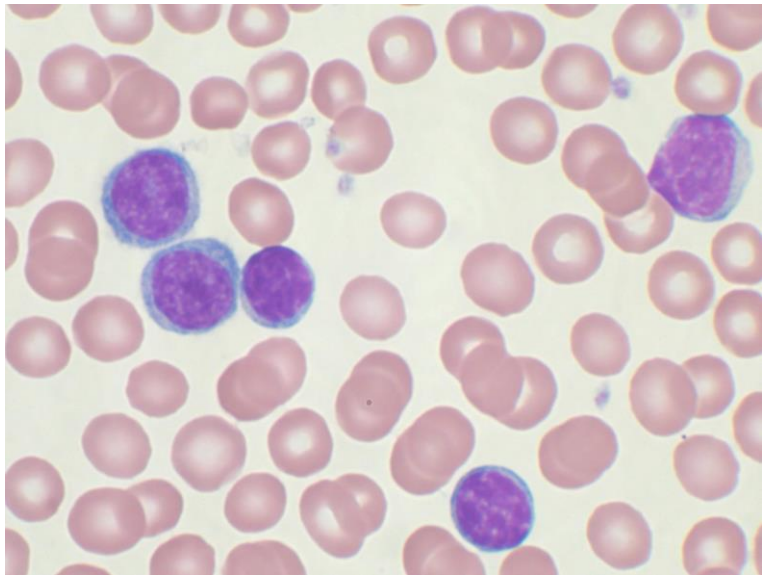
Large lymphocytes: They are believed to be small lymphocytes activated by the specific antigens.

- Diameter: 12-15 µm
- 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 azurophillic granules.

Small lymphocytes: They are the commonest.



- Diameter: 7-9 µm
- 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 azurophillic 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

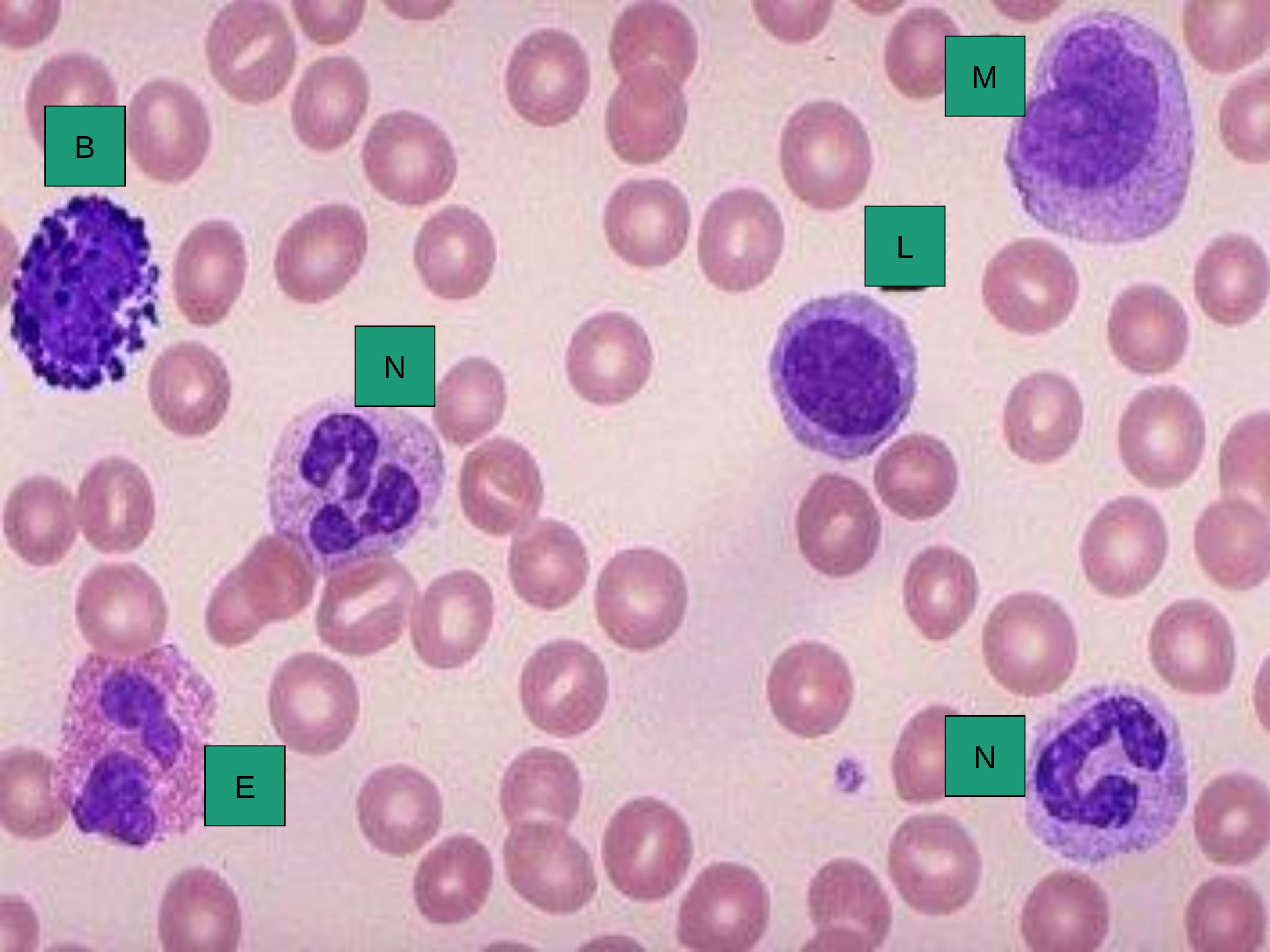
- **Shape:** They are rounded cells
- **Size:** 12-20 microns in diameter.
- **Life Span:** Monocytes circulate in blood about three days after which they leave blood to the connective tissues, where they differentiate into macrophages.
- **Structure:**

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 azurophillic 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