Leucocytes (WBCs)

By
Dr. Nour A. Mohammed
Associate professor of physiology
Faculty of Medicine, Mutah University
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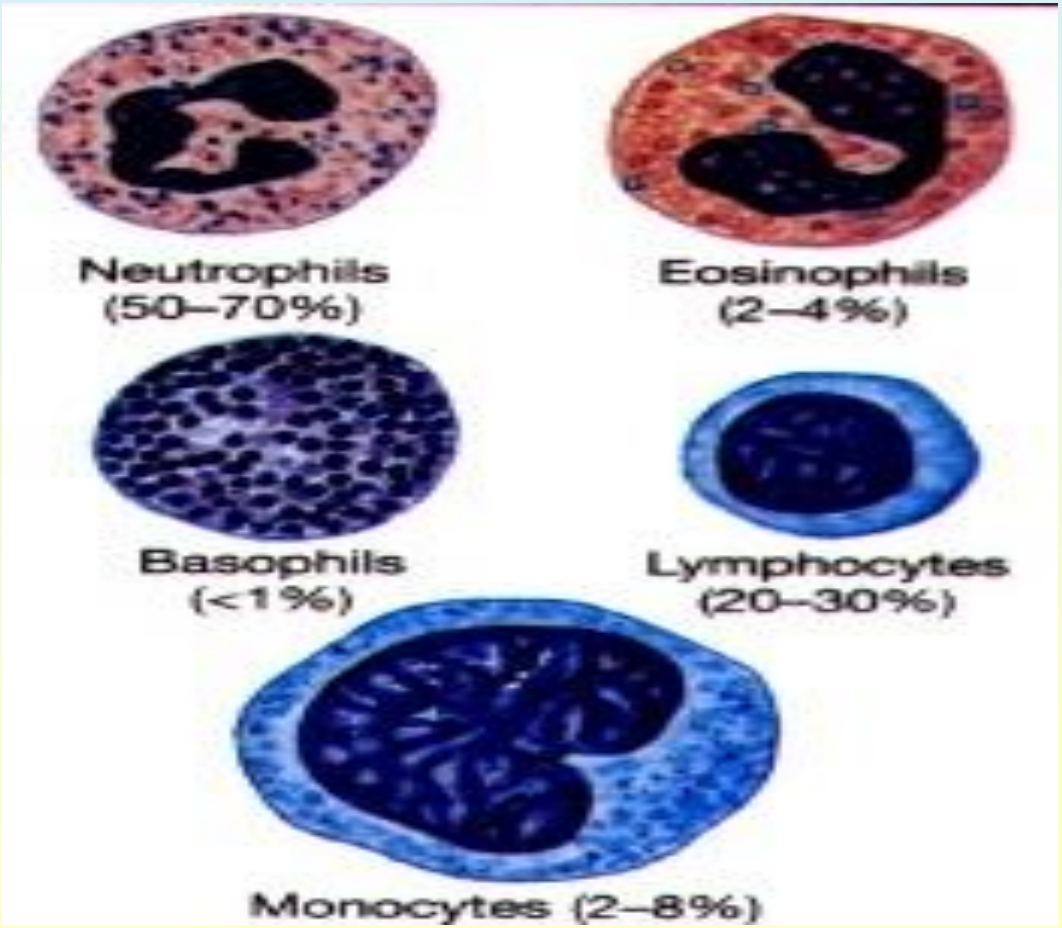
A. Granulocytes

- 1. nucleus: >1 lobe
- 2. granules
- 3. life span: few days
- 4. neutrophils, eosinophils, basophils

B. A granulocytes

1. nucleus: round or horseshoe shape
2. no specific granules
3. lymphocytes & monocytes

White Blood Cells (Leucocytes) (WBCs)



White Blood Cells (Leucocytes) (WBCs)

Number 4.000-11.000/mm3 in adult man

increased in children

Origin The granulocytes and monocytes are formed from the bone marrow only, but the lymphocytes are formed in the lymphatic tissues

(lymph node, spleen, thymus, tonsils, and Peyer's patches of GIT)

Even 75% of the bone marrow form WBCs, its number is less than RBCs count because it has short life span.

- ***Life span:***
- ***In granulocytes***

4-8 hours in the circulation

4-5 days in the tissue.

In infection there is rapid destruction.

- ***In monocytes***

10-20 hours in the circulation then enter the tissue to become tissue macrophages and can live for months.

- ***In lymphocytes***

variable according to the body need.

They circulate in between the lymphatic tissue and the blood

*Differential leucocytic count

- According to presence or absence of granules in their cytoplasm they are divided into :

I- *Granulocytes*

(1) Neutrophils (both granules) 40-70%

(2) Eosinophils: (acidophils) 1-4%

(3) Basophils: (basic granules) 0-1%

II- *Non-granulocytes* **(1) Lymphocytes: 20-45%**

(2) Monocytes: 2-8%

This typing can be done by staining the blood by leishman stain or by specialized automatic machine

* Types and Functions

- **(1) Neutrophils:**

Characters:

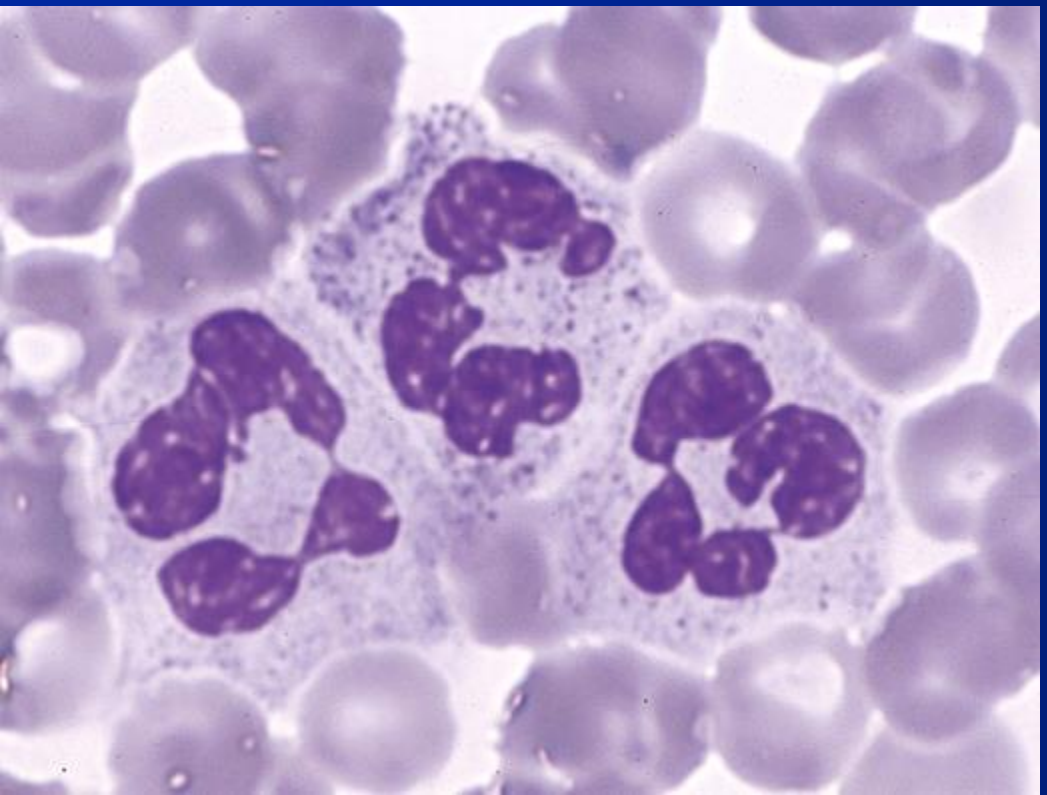
40-70% of total number.

They contain small granules of both acidic and basic

Their nucleus are formed of 2-5 lobes connected by thin chromatin filaments

Neutrophils

1. 40-70% of leukocytes
2. nucleus: 2-5 lobes **connected by thin chromatin filaments**



They contain small granules of both acidic and basic

Function

- The main function is the defensive function when bacteria invade the body

- ***(1) Margination***

The Neutrophils aggregate and stick to the damaged capillary endothelial surface by protein called (Selectins) .

- ***(2) Chemotaxis***

Some substances released at site of infection (degenerative products, bacterial toxins & complement system) lead to attraction of leucocytes from near capillary (<100 μ distance) to migrate towards the inflammed area (positive chemotaxis)

(3) Diapedesis:

- WBCs bind firmly to protein (integrin) ,then they can squeeze themselves through the pores of the capillaries to outside.
- In infected area these pores increase in size to facilitate diapedesis

(4) Amoeboid movement:

WBCs are motile cells and move by ameboid motion by 40 μ/min

(5) Phagocytosis

This is the power of leucocytes to engulf foreign materials as bacteria, toxins and dead cells

Then ingest these material via proteolytic enzymes of lysosomes

bactericidal agent as hydrogen peroxide (H_2O_2) can kill bacteria.

A neutrophil can phagocytize 5-20 bacteria before the neutrophils die and form pus

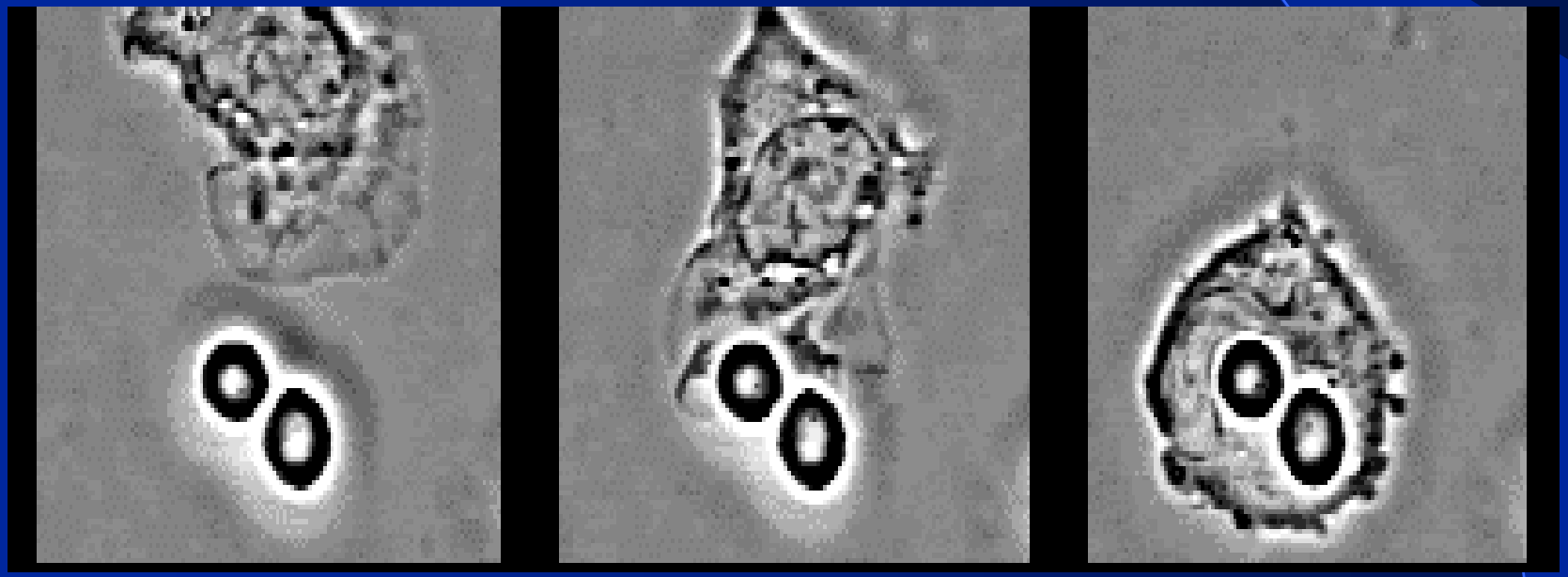
(6) Opsonization

which makes the foreign materials more susceptible for phagocytosis

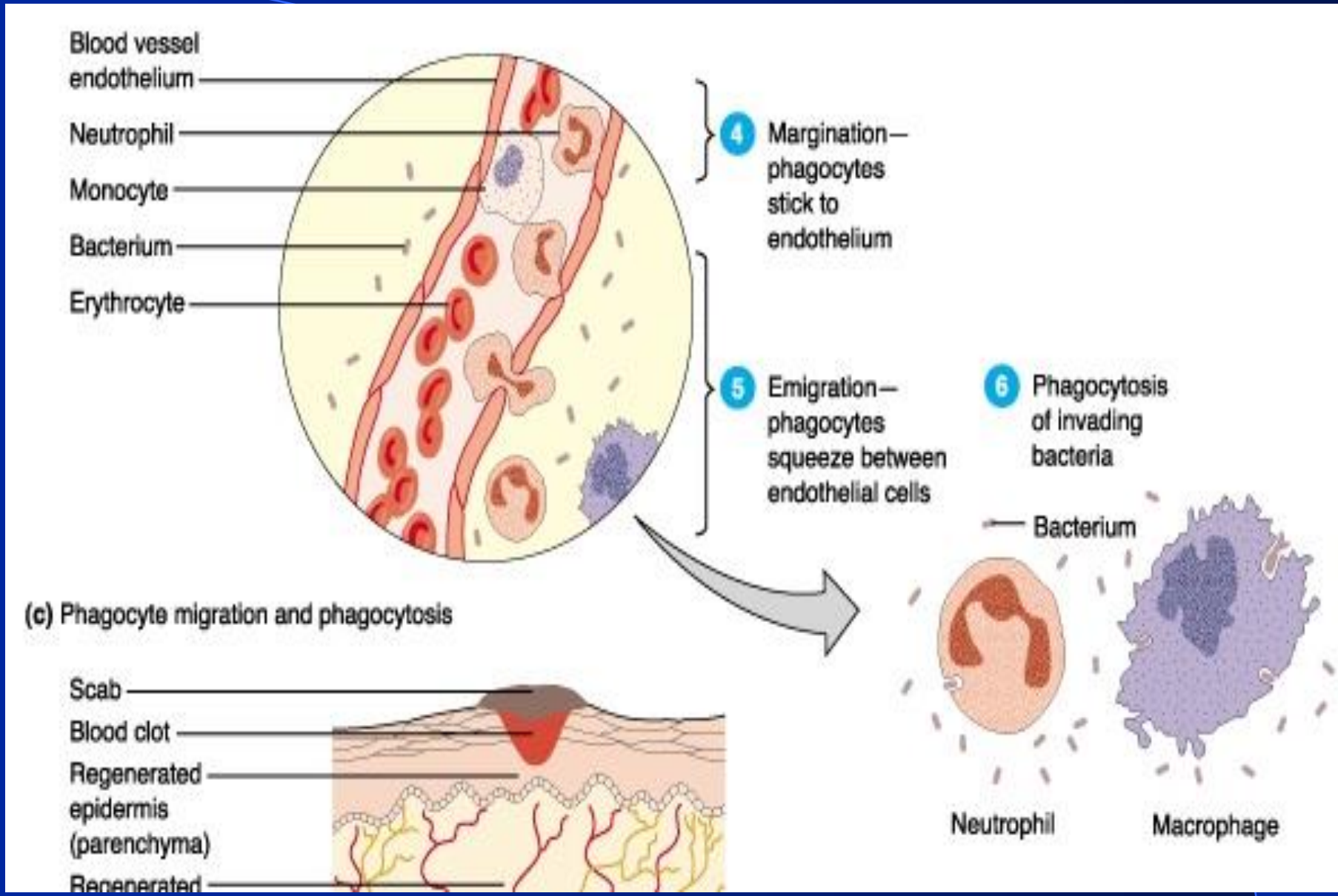
Phagocytosis

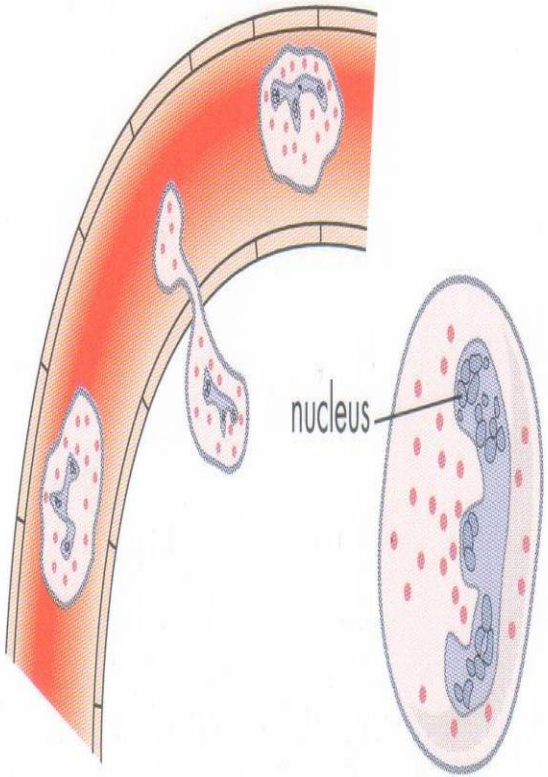
- Lysosomes contain enzymes = degrade biomolecules.

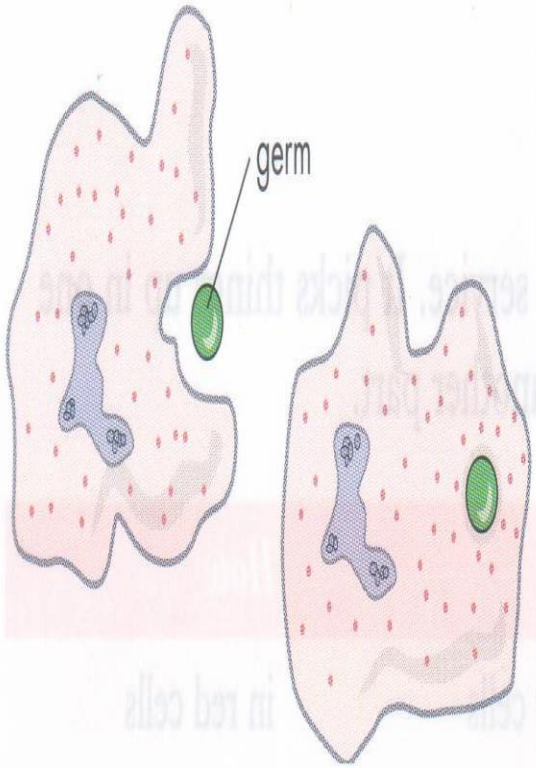
- E.g. acid hydrolases, lysozyme, neutral proteases, myeloperoxidase, lactoferrin, & phospholipase A.

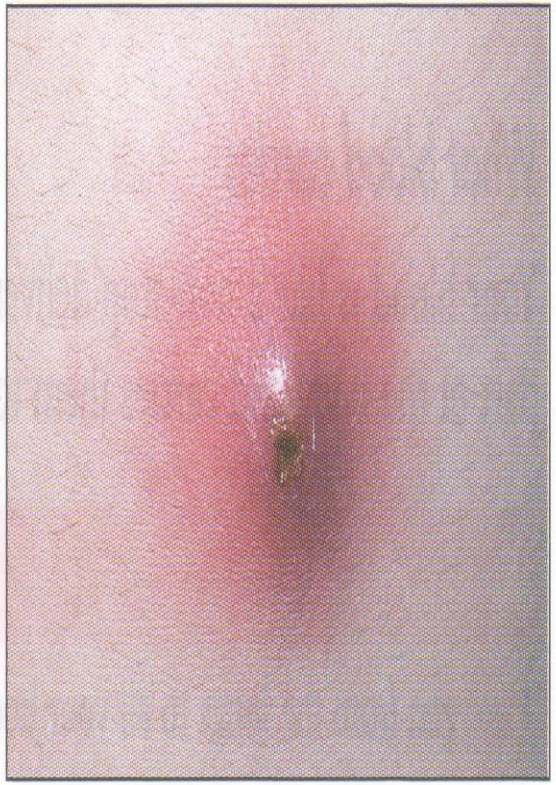


Human macrophage engulfing the fungus *Candida albicans*.


Blood vessel endothelium
Neutrophil
Monocyte
Bacterium
Erythrocyte
4 Margination—phagocytes stick to endothelium
5 Emigration—phagocytes squeeze between endothelial cells
6 Phagocytosis of invading bacteria
Bacterium
Neutrophil
Macrophage
(c) Phagocyte migration and phagocytosis
Scab
Blood clot
Regenerated epidermis (parenchyma)
Regenerated







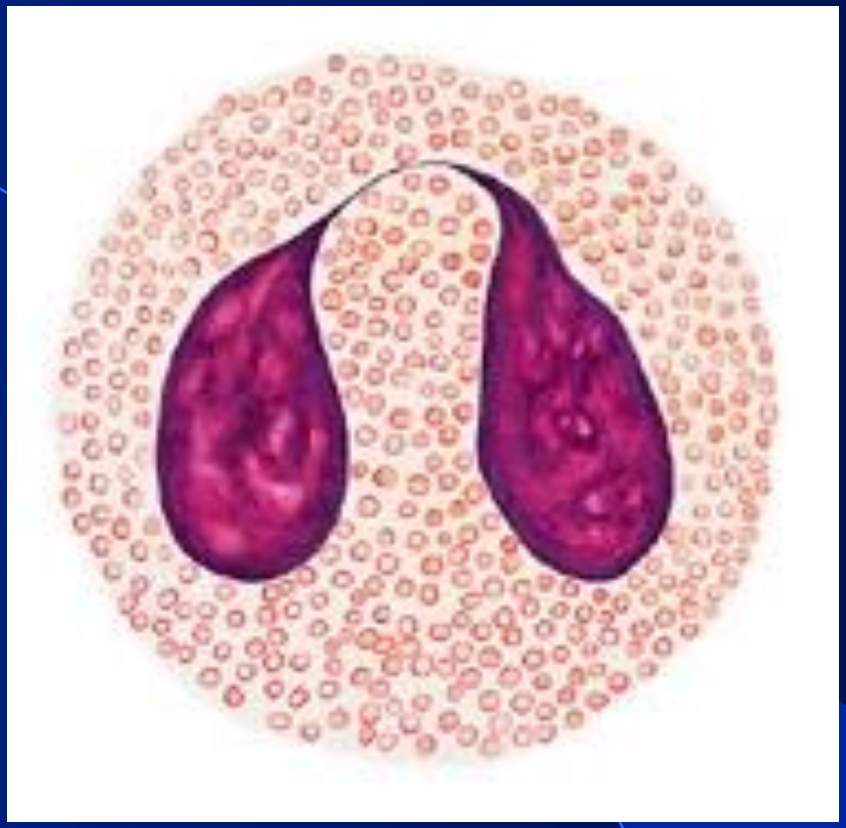
1 The phagocytes pass out through capillary walls and into the infected tissue.

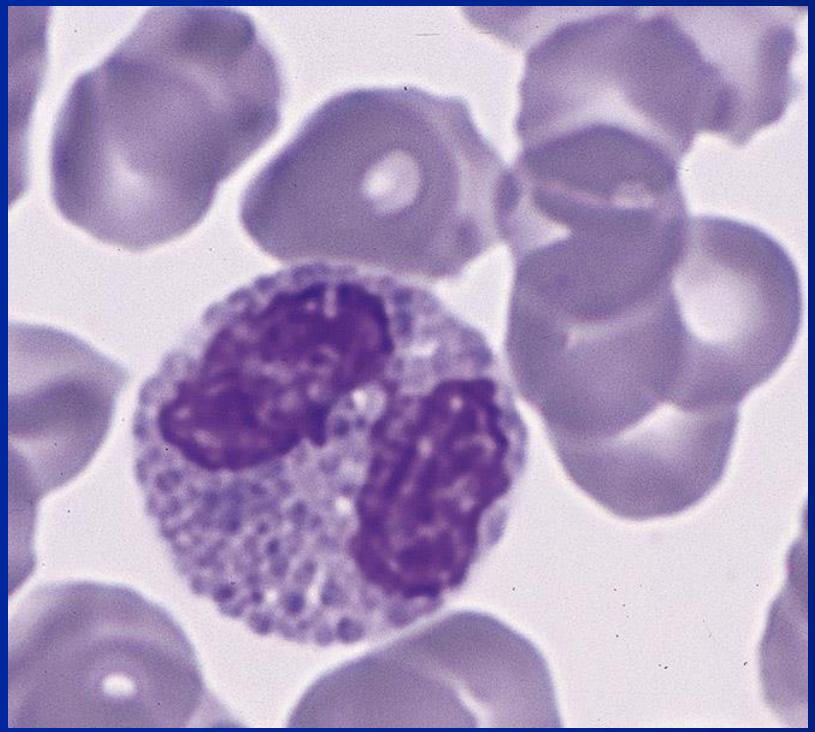
2 They change shape to surround the germs. They produce enzymes to kill and digest them.

3 Phagocytes live for only a short time. Dead phagocytes, dead germs and liquid form **pus** in the infected area.

Eosinophils

- eosinophilic granules Antiparasitic & modulate inflammation





(2) Eosinophils

- **Characters**

1-4% of total number

They contain red granules

They have bilobed nucleus

- **Function**

1- They are weak phagocytes

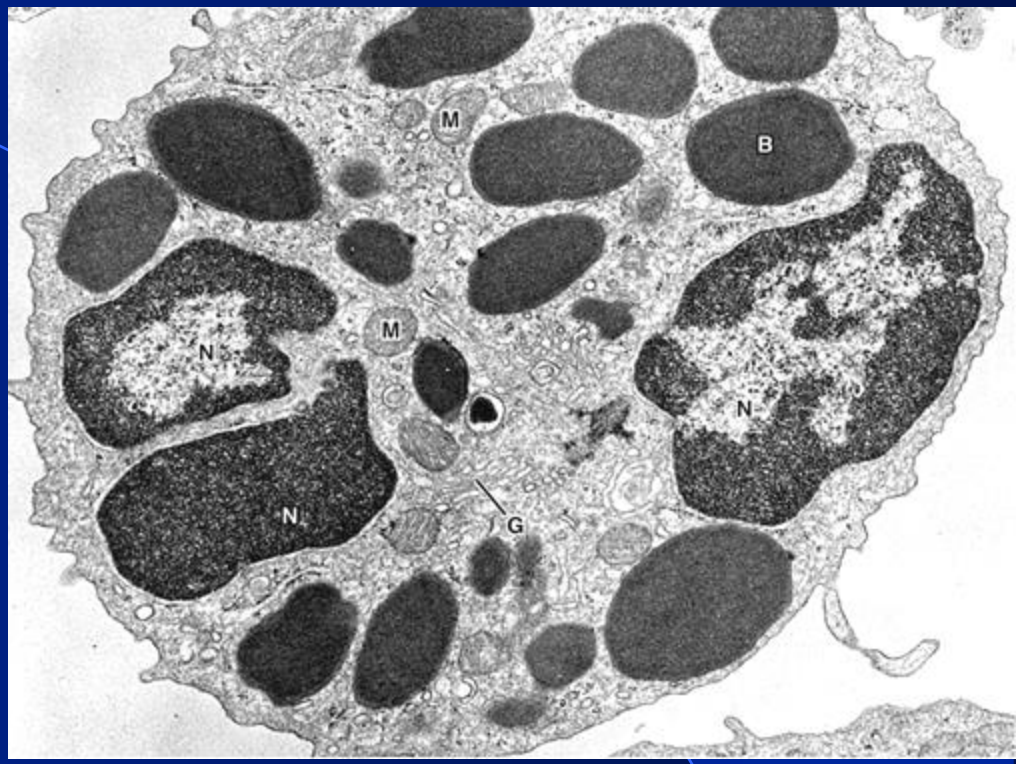
2- They increase in parasitic infections (ascaris) and by diabedesis, amoeboid movement and chemotaxis they attack the parasites and release substances to kill many of them

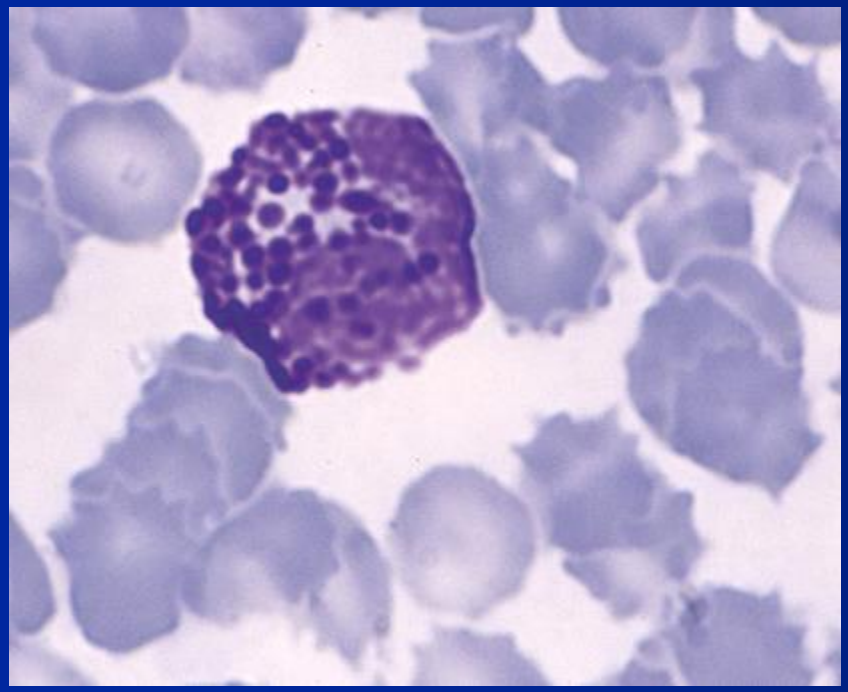
3- They increased in allergic conditions by the release of eosinophil chemotactic factor released from the mast cells and basophiles. Eosinophils phagocytose the antigen-antibody complexes and release substances to neutralize the histamine

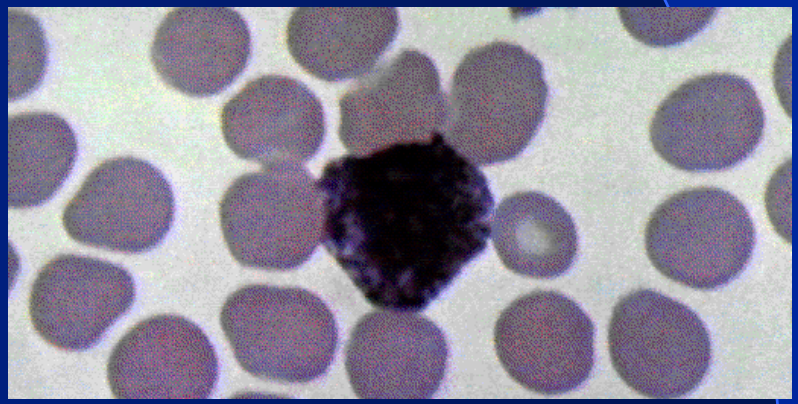
4- They may produce profibrinolysin → fibrinolysin which digest fibrin clot

Basophils

1. < 1% of leukocytes
2. basophilic granules







(3) Basophils

- **Characters:**

0-1% of total number

They contain deep blue granules with staining

In the connective tissue, they are called the mast cells

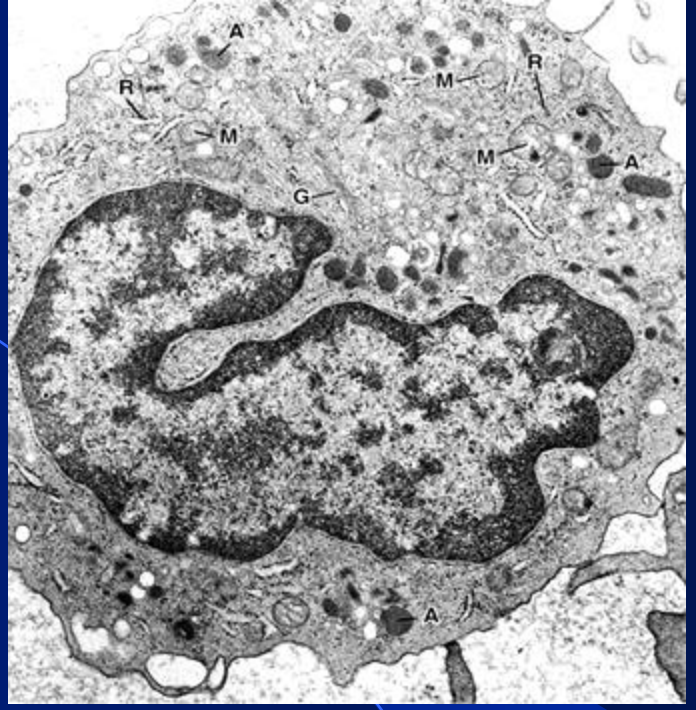
- **Function**

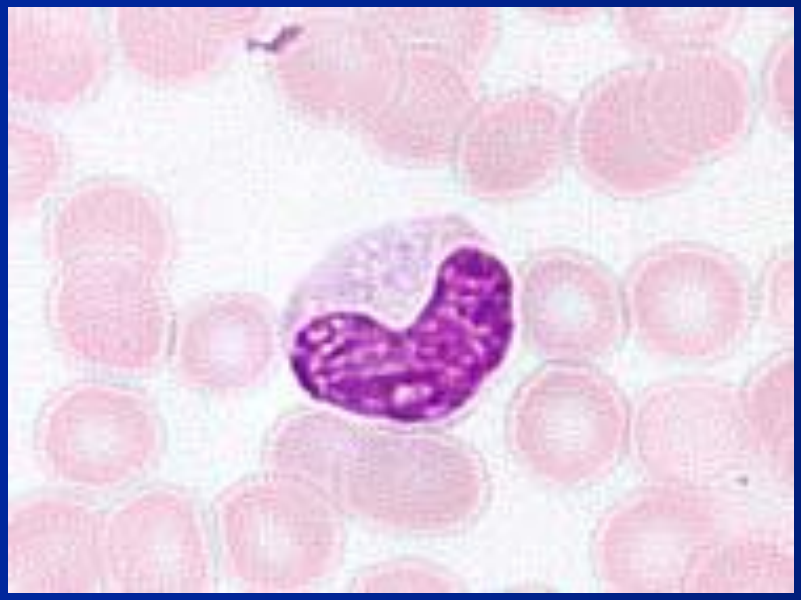
They form heparin as anticoagulant

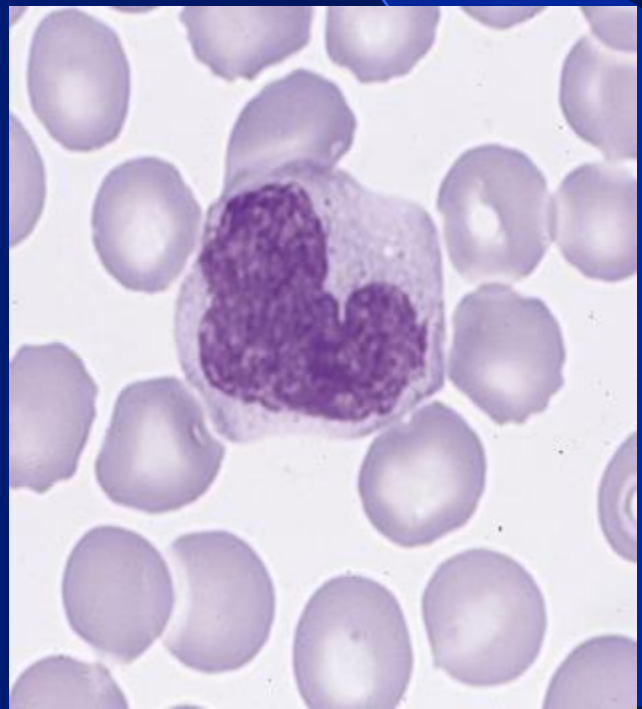
They release histamine and other allergic mediators as serotonin, bradykinin and lysosomal enzymes to mediate allergic manifestation as vasodilatation and tissue reaction

Monocytes

1. nucleus: oval, horseshoe/kidney shaped, eccentric
2. become wandering macrophages after diapedesis







(4) Monocytes

Characters

2-8% of total number

They contain agranular cytoplasm but when they enter the tissues they swell and their cytoplasm become filled by large number of lysosomes and then they are called macrophages

They have oval or kidney shaped nucleus

Function

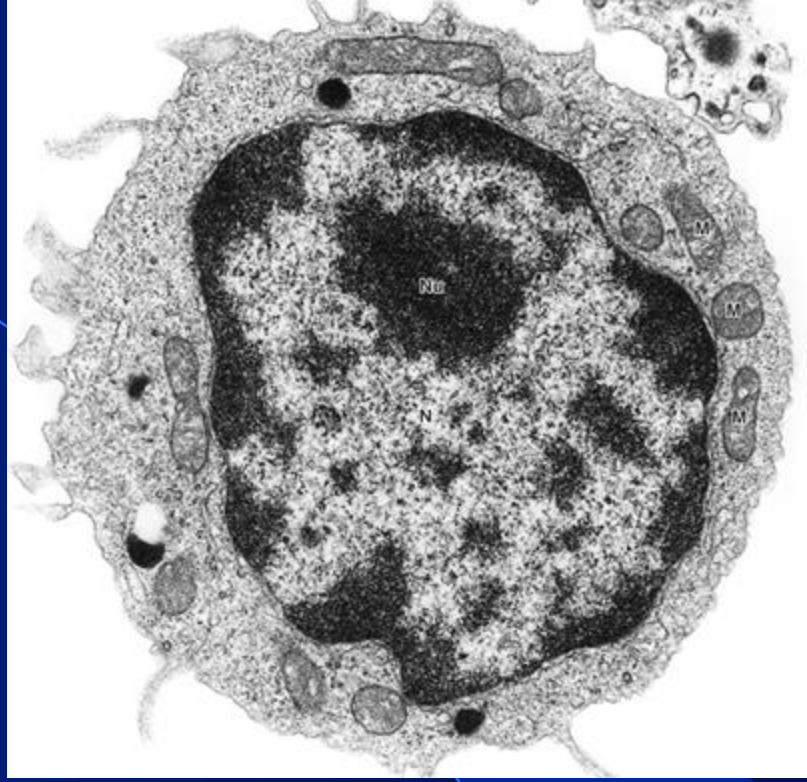
Phagocytosis as in neutrophils but with more powerful effect

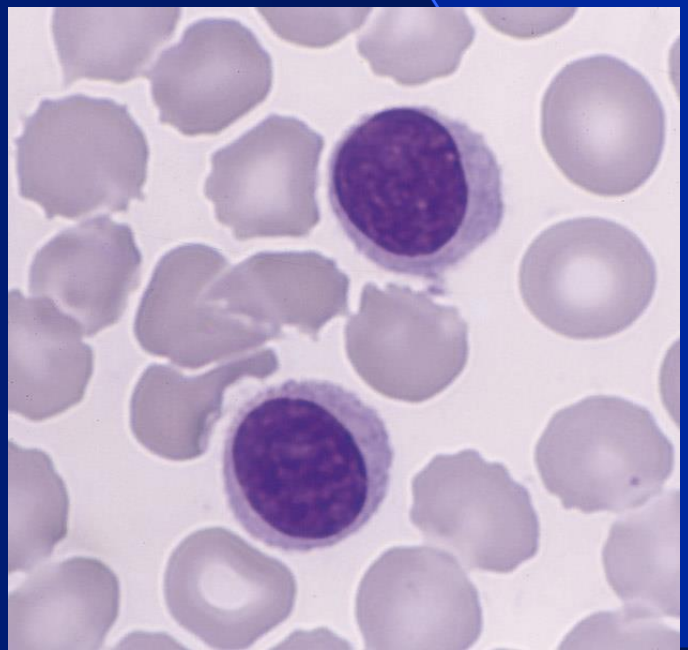
Macrophages help the function of T-and B-lymphocytes by presenting the antigen to these cells

Macrophages release many chemical substances to increase the inflammatory and allergic reactions against organisms

Lymphocytes

1. nucleus: spherical, intensely stained
2. cytoplasm: scanty





(5) Lymphocytes

- **Characters**

20-45% of total number

They are the smallest type of W.B.Cs and contain large rounded nucleus

- **Function**

There are two types of lymphocytes

***1) B-lymphocytes*:**

They are changed to plasma cells and are responsible for humeral immunity or antibody- mediated immunity

2) T-lymphocytes

They complete their development in the thymus gland and are responsible for cellular immunity or cell-mediated immunity

Leucocytosis

- **A- Physiological Leucocytosis**

  - Increase in number of leucocytes above 11.000/mm3. It occurs in muscular exercise, emotions, cold bath, cold or hot weather, pregnancy, labour, pain, anaesthesia and after meals.

- **B- Pathological Leucocytosis**

Neutrophilia

Increase number of neutrophils as in cases of:

Infections **of all types as acute or chronic, bacterial, viral or fungal.**

Inflammation **as rheumatic fever**

Tissue damage **as trauma, burn**

Malignant tumours

Smoking

Eosinophilia

- ↑ eosinophils due to
  - **Allergic conditions as asthma, hay fever, skin allergy**
  - **Parasites**
  - **Leukemia**

Basophiles

- ↑ basophils as in allergy or leukemia

Monocytosis

As in chronic infections as tuberculosis or in leukemia.

Lymphocytosis

As in chronic viral and bacterial infections and in leukemia.

Leukaemia

It is a malignant disease of bone marrow causing marked increase in WBCs may reach 500.000/mm3

Leukaemia is associated with anemia and bleeding tendency due to :

decrease in bone marrow area responsible for RBCs and platelet synthesis respectively

Leucopenia

- It means a decrease in the total leucocytic count below 4.000/mm3
- In this condition the body is not protected against infections and death may occur
- It is caused by

1- Bone marrow depression by radiation, drugs as cancer chemotherapy

2- Some bacterial infections as typhoid fever, brucellosis

3- Some viral infections as AIDS, influenza, hepatitis


THank you