

# Leucocytes

(WBCs)

By

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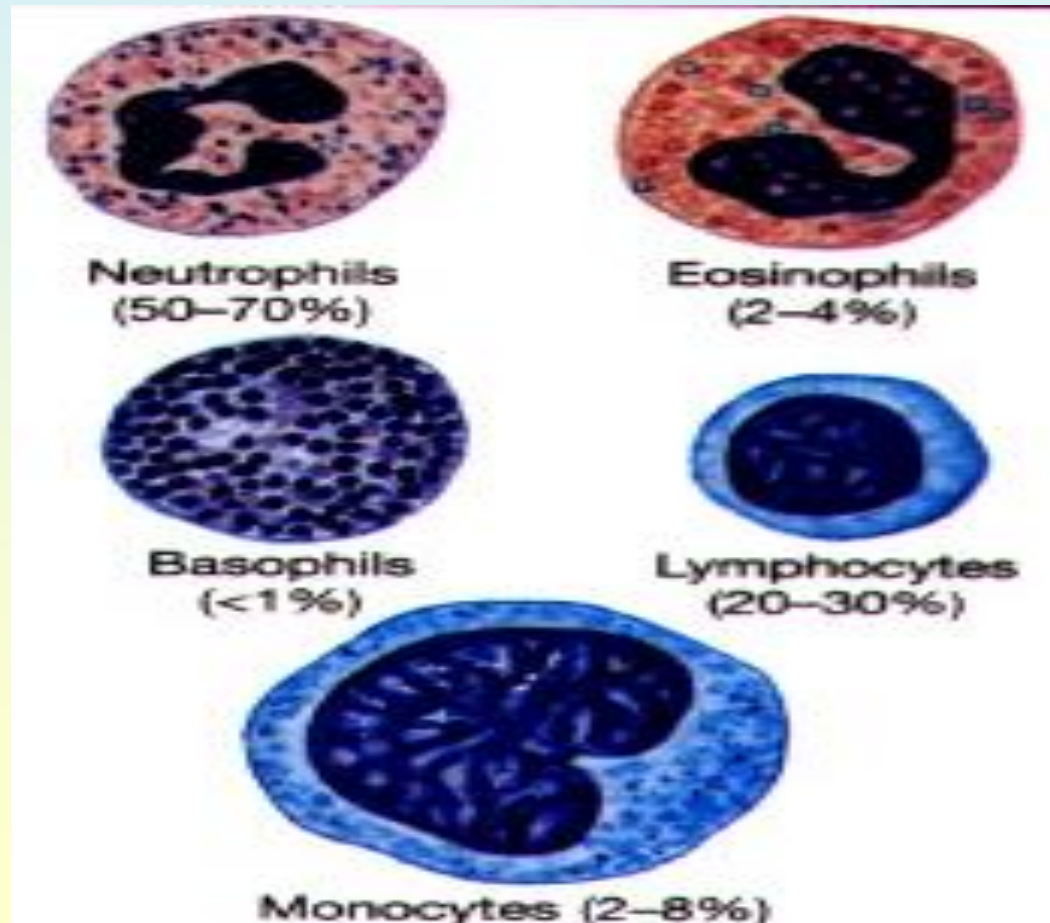
## **A. Granulocytes**

- 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/mm<sup>3</sup> in adult man**  
**increased in children**

**Origin**                    **Bone marrow**

**N.B: T-lymphocyte complete its maturation in  
thymus**

**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***

3 days 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 (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%**

**It can be done by staining the blood by leishman stain or by specialized automatic machine**

# \* Types and Functions

## □ (1) Neutrophils:

### Characters:

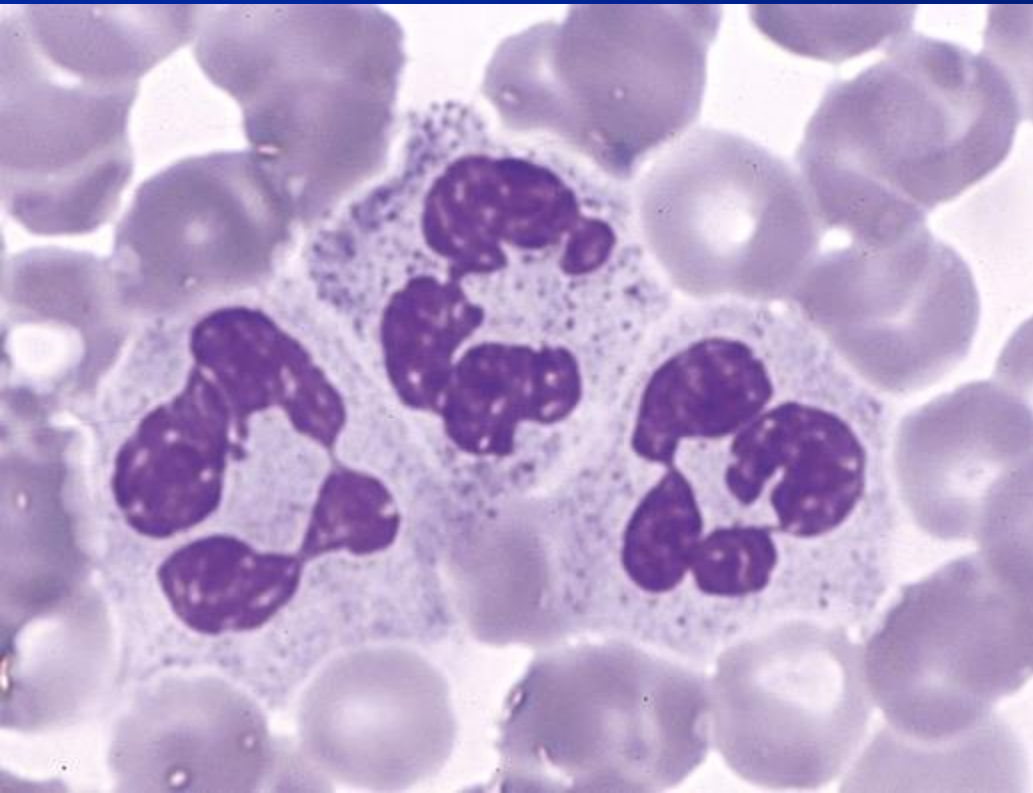
40-70% of total number.

They contain neutral (faint pink) small granules

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  
neutral granules**

# 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  $\mu$  distance) to migrate towards the inflamed 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 amoeboid motion by  $40 \mu/\text{min}$

### (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 ( $\text{H}_2\text{O}_2$ ) can kill bacteria.

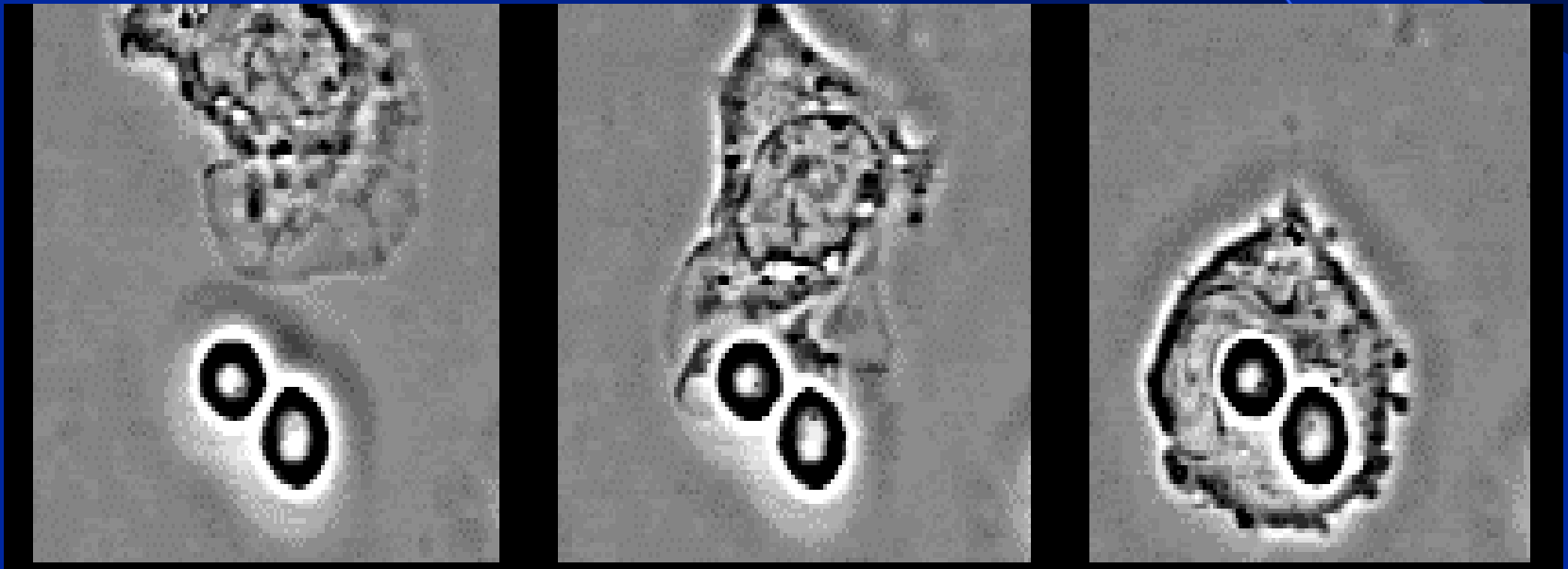
A neutrophil can phagocytize 5-20 bacteria before the neutrophils die and form pus

### (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 foreign invader**

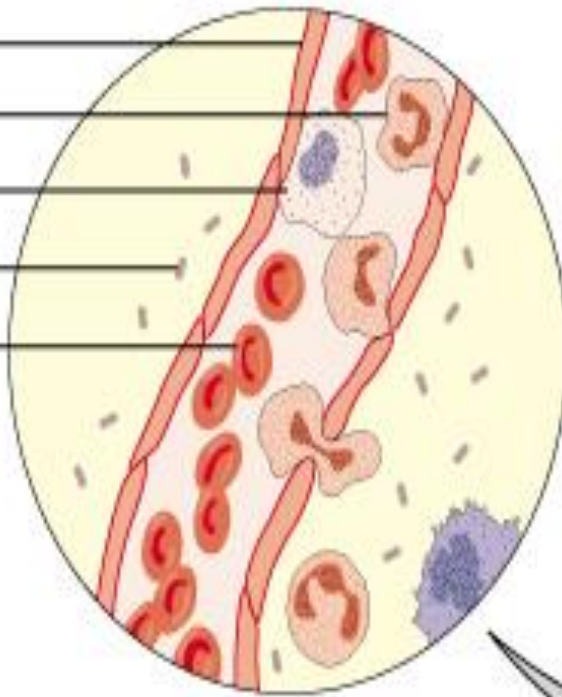
Blood vessel  
endothelium

Neutrophil

Monocyte

Bacterium

Erythrocyte

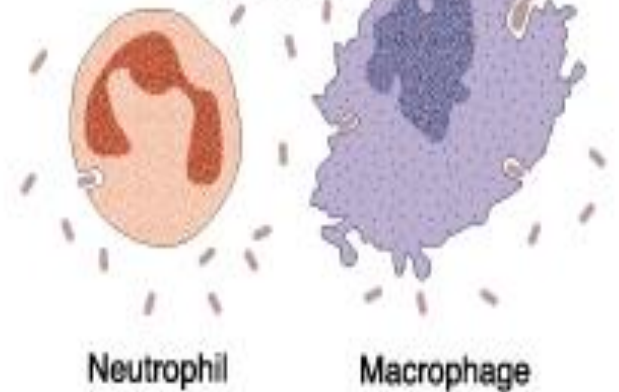


4 Margination—  
phagocytes  
stick to  
endothelium

5 Emigration—  
phagocytes  
squeeze between  
endothelial cells

6 Phagocytosis  
of invading  
bacteria

Bacterium



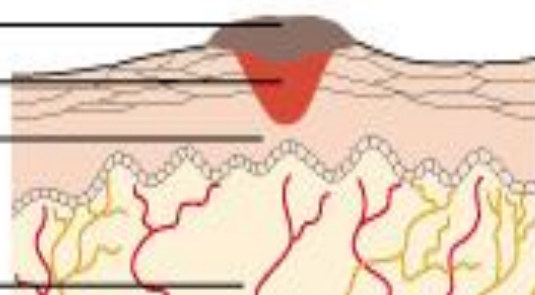
(c) Phagocyte migration and phagocytosis

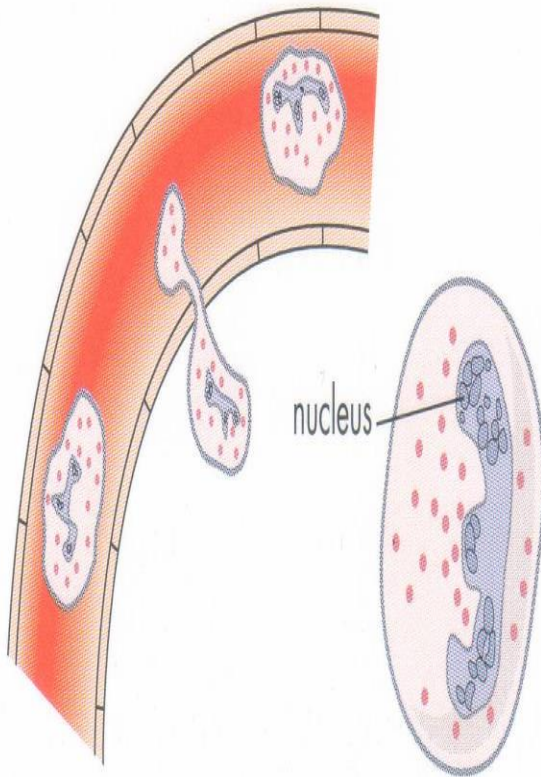
Scab

Blood clot

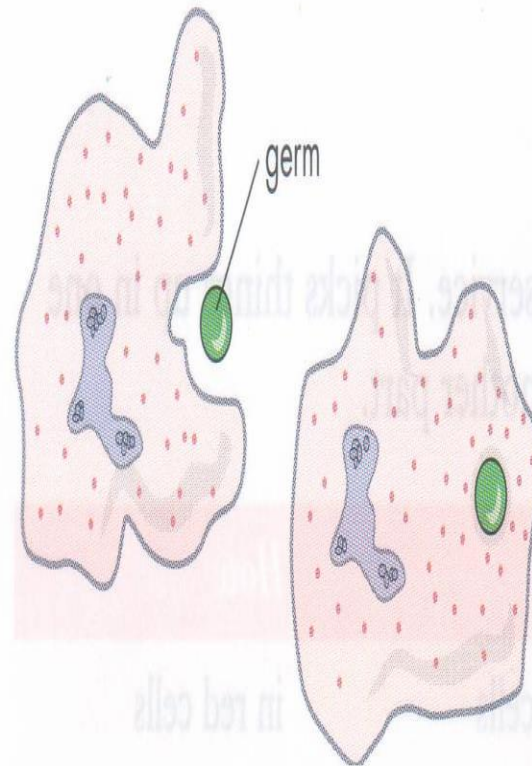
Regenerated  
epidermis  
(parenchyma)

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  
Anti-parasitic &  
modulate inflammation



## (2) Eosinophils

### □ Characters

1-4% of total number

They contain red granules

They have bilobed nucleus

### □ Function

1- They are weak phagocytes

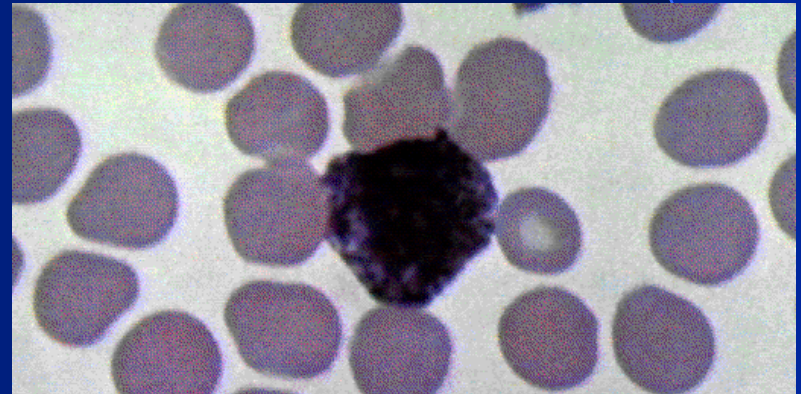
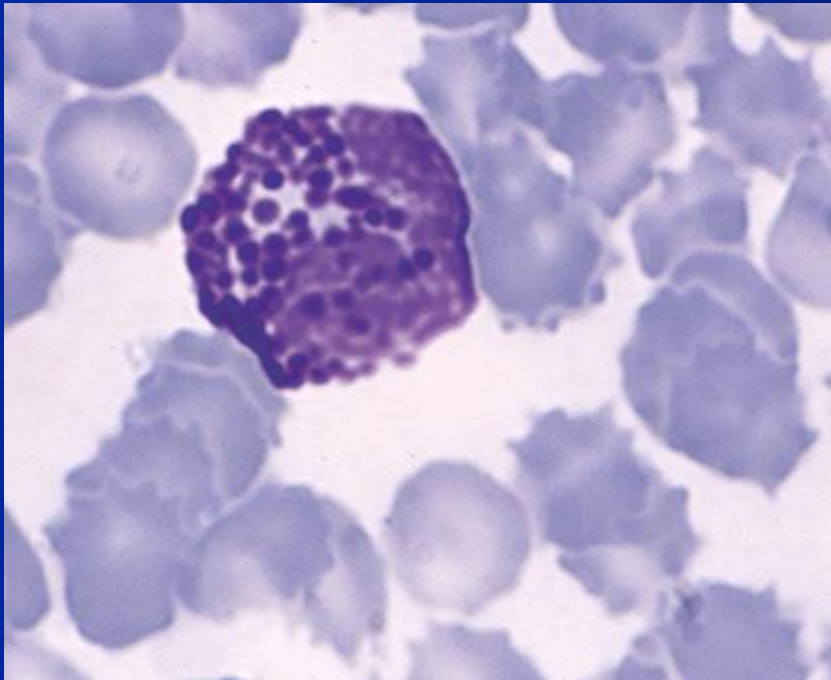
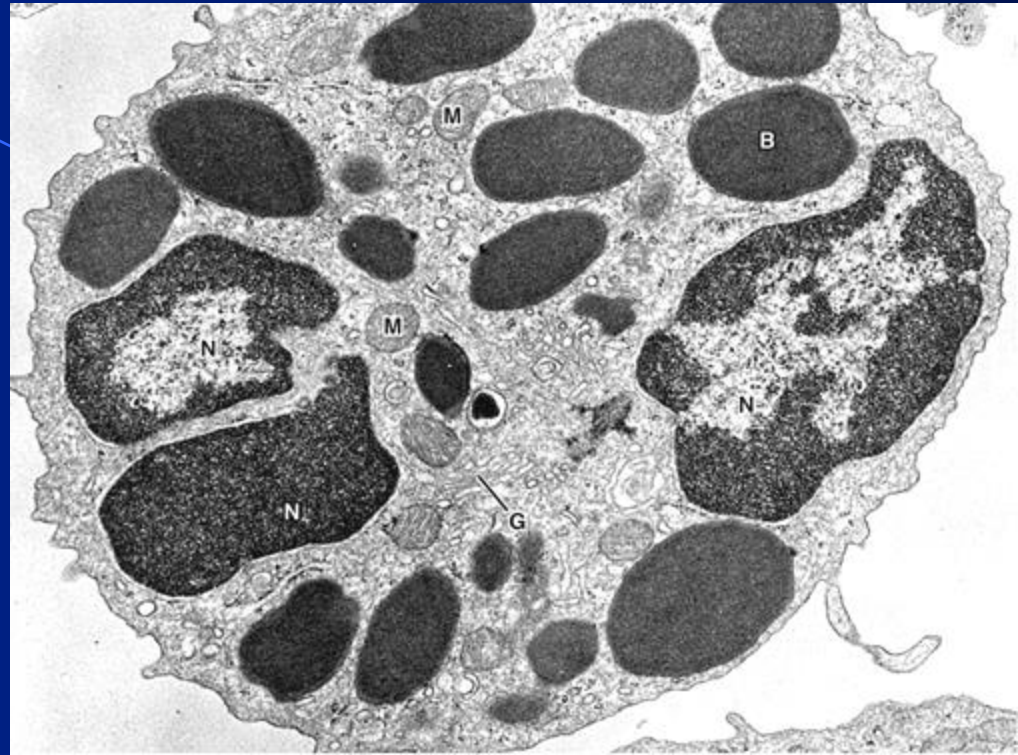
2- They increase in **parasitic** infections (ascaris) and by diapedesis, amoeboid movement and chemotaxis they attack the parasites and release substances (e.g. peroxidase) to kill many of them

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

4- They may produce pro-fibrinolysin → fibrinolysin which digests 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**

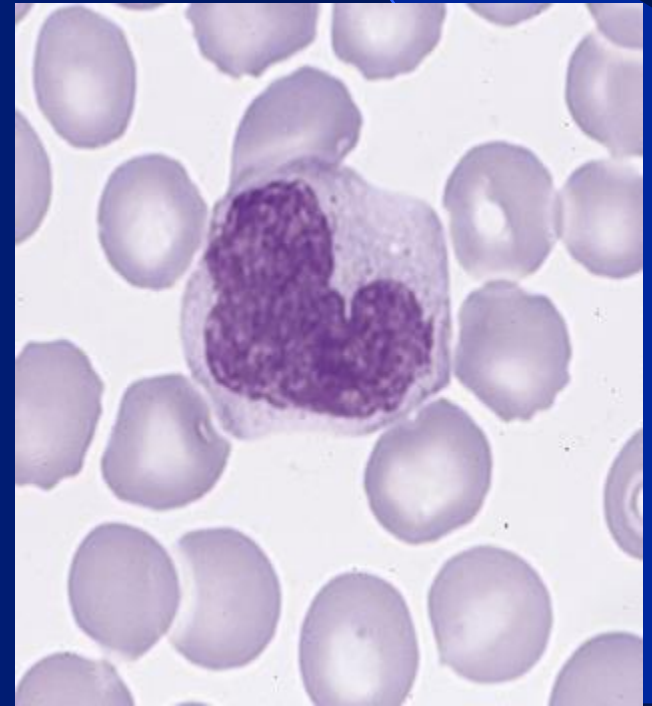
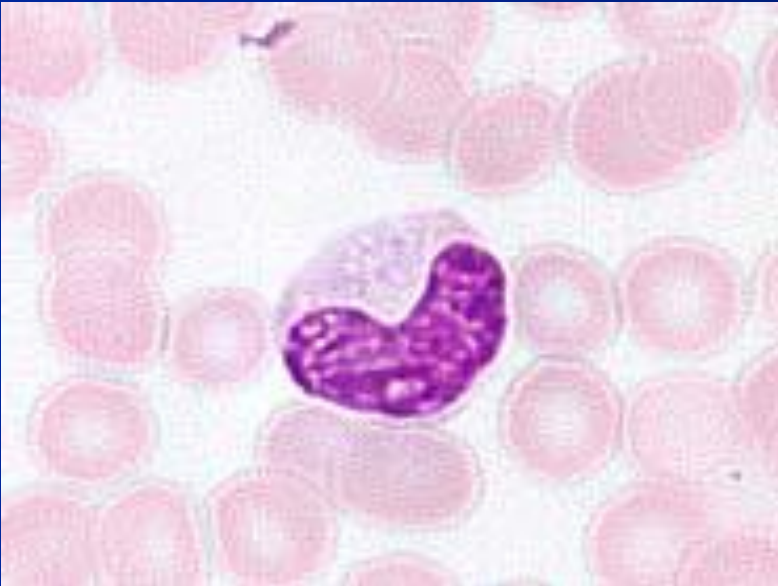
**They are like mast cells**

## **□ 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 don't have specific granules in their cytoplasm, 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**

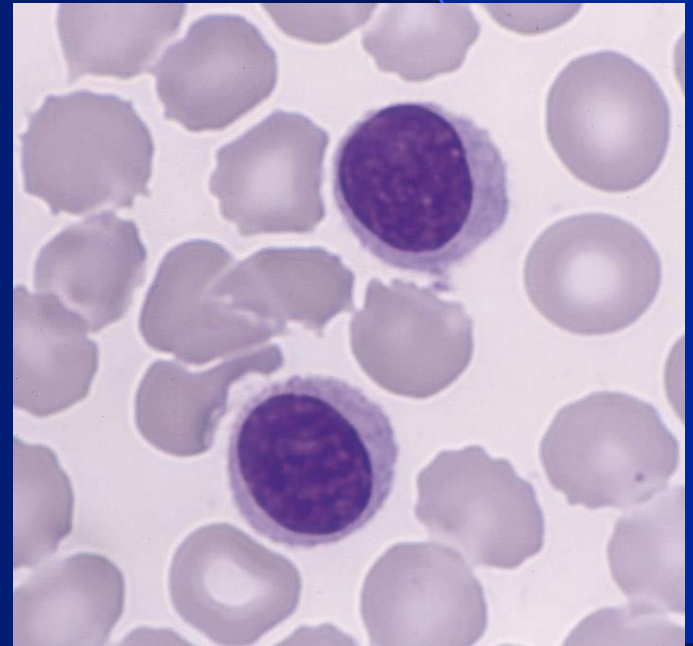
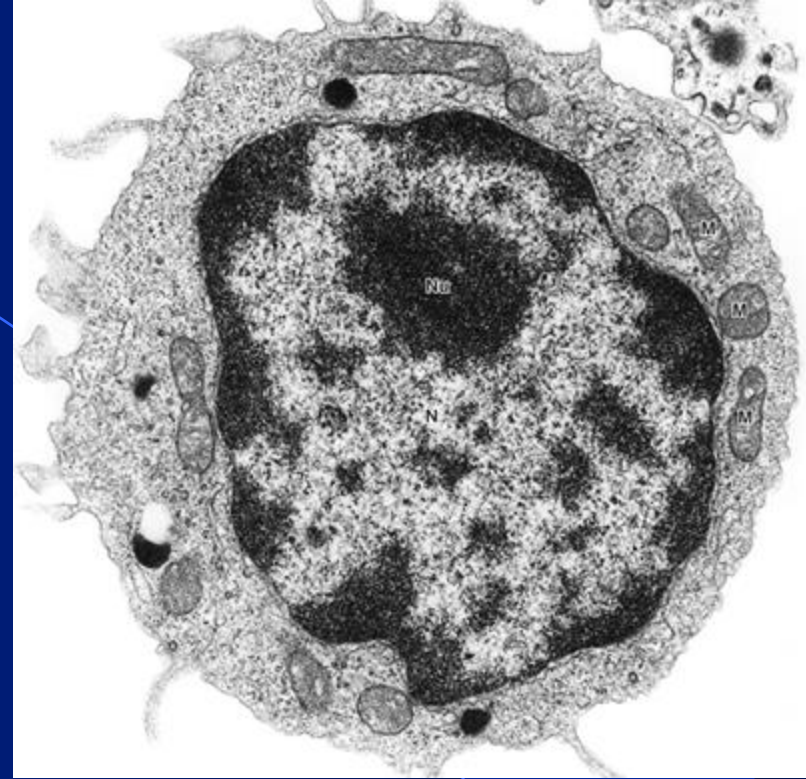
**Phagocytosis as in neutrophils but with more powerful effect**

**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/mm<sup>3</sup>. 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/mm<sup>3</sup>**

**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/mm<sup>3</sup>
- 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

A vibrant sunset scene with a body of water in the foreground and dark hills in the distance. The sky is a mix of orange, red, and purple, with some clouds. The text 'THank you' is overlaid in a blue, bold, sans-serif font with a white outline. The 'T' is all caps, while 'Hank you' is lowercase. The entire image is framed by a white border, which is itself set against a dark blue background.

**THank you**