

Leucocytes

(WBCs)

By

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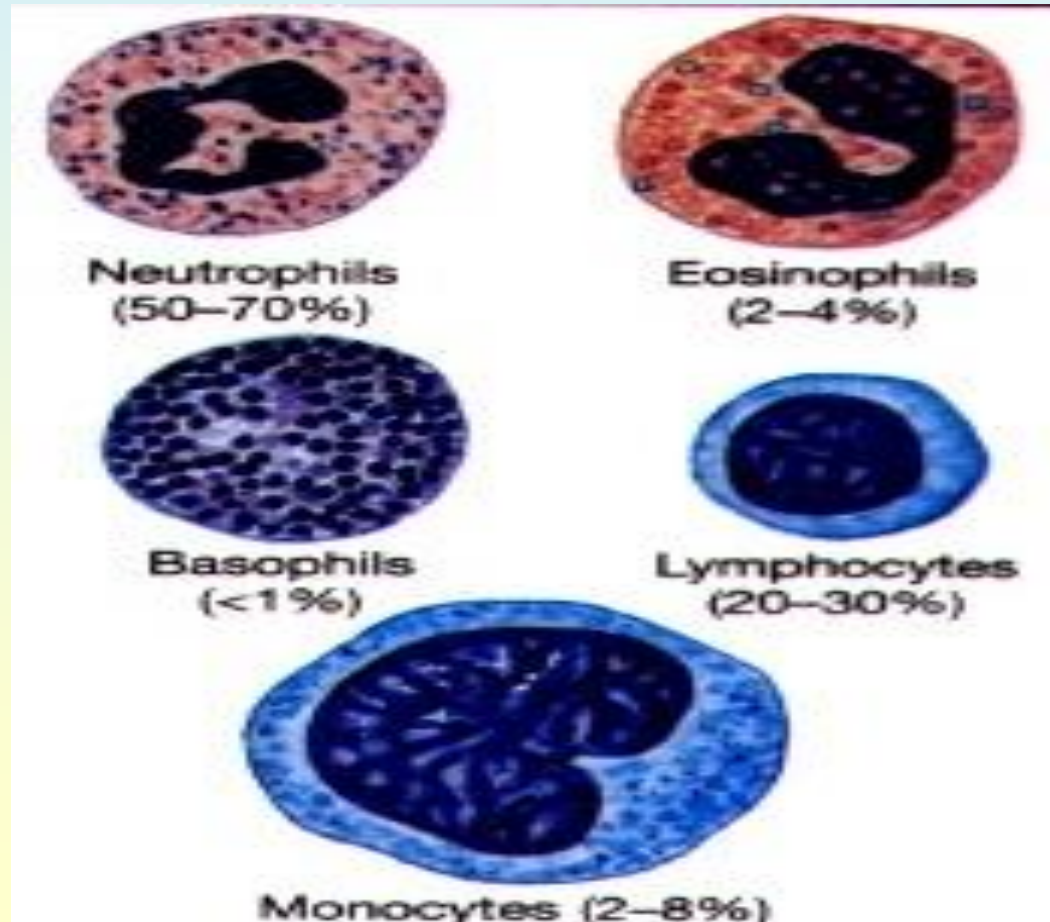
A. Granulocytes

- 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/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)

Due to short life span. *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.

الزرقام ما في تدقيق

Shorter lifespan

May be altered.

□ *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

3 days → 3 months.

*Differential leucocytic count

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

To be considered } ~ total count
~ differential count.

I- Granulocytes

- (1) Neutrophils (both granules) 40-70% * Most abundant.
- (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

By blood film.

* Types and Functions

□ (1) Neutrophils:



Characters:

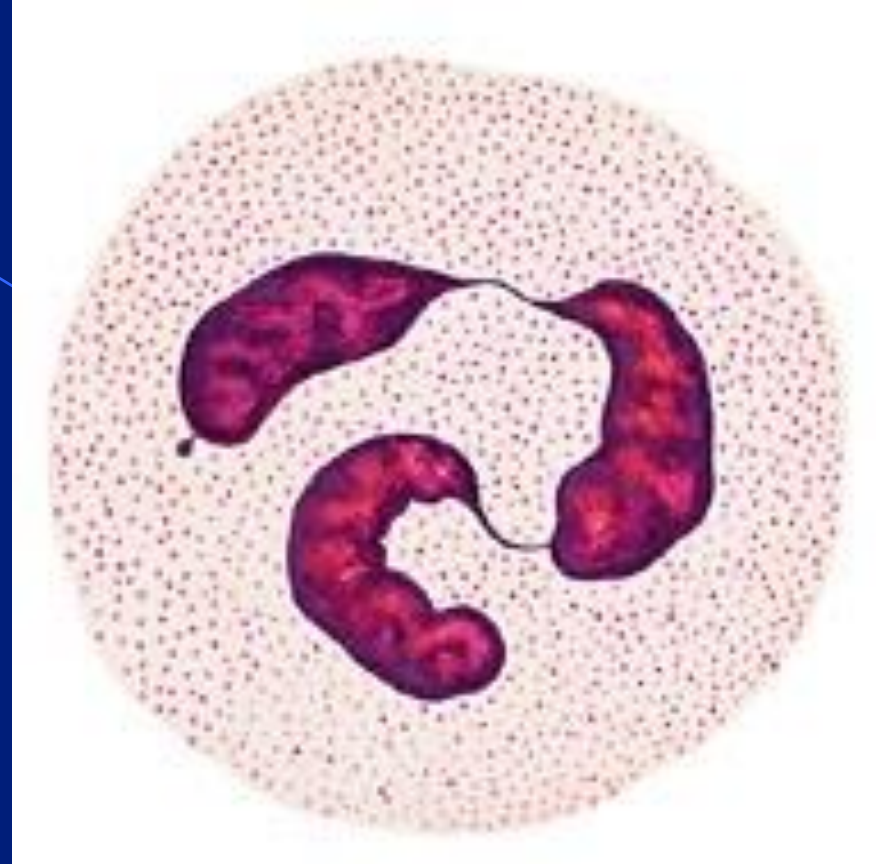
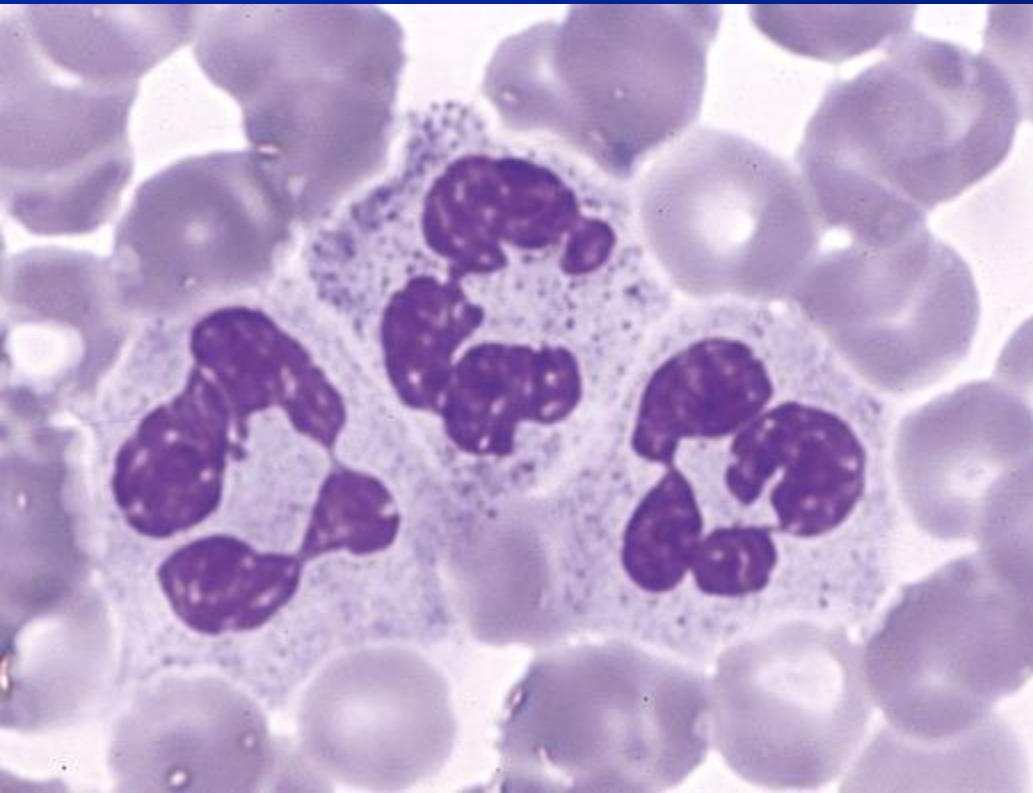
40-70% of total number.

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

phagocytosis :

- first line in tissue \rightarrow Macrophage.
- calling in blood \rightarrow Neutrophils.



□ (2) Margination

Rolling \rightarrow Row

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

□ (1) Chemotaxis: Calling (Attraction)

Calling RBC's. RBC's \rightarrow Tissues.

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)

increase in permeability
Widening in fenestration.

(3) Diapedesis:

Fenestration
هو لباع او
neutrophils.

- 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:

زح حركه اناوي الطيعة
اصيبا

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

(5) Phagocytosis

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

= cell engulfment → macrophage.

Then ingest these material via proteolytic enzymes of lysosomes

bactericidal agent as hydrogen peroxide (H₂O₂) can kill bacteria.

& High Oxygen RS.

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

(6) Opsonization

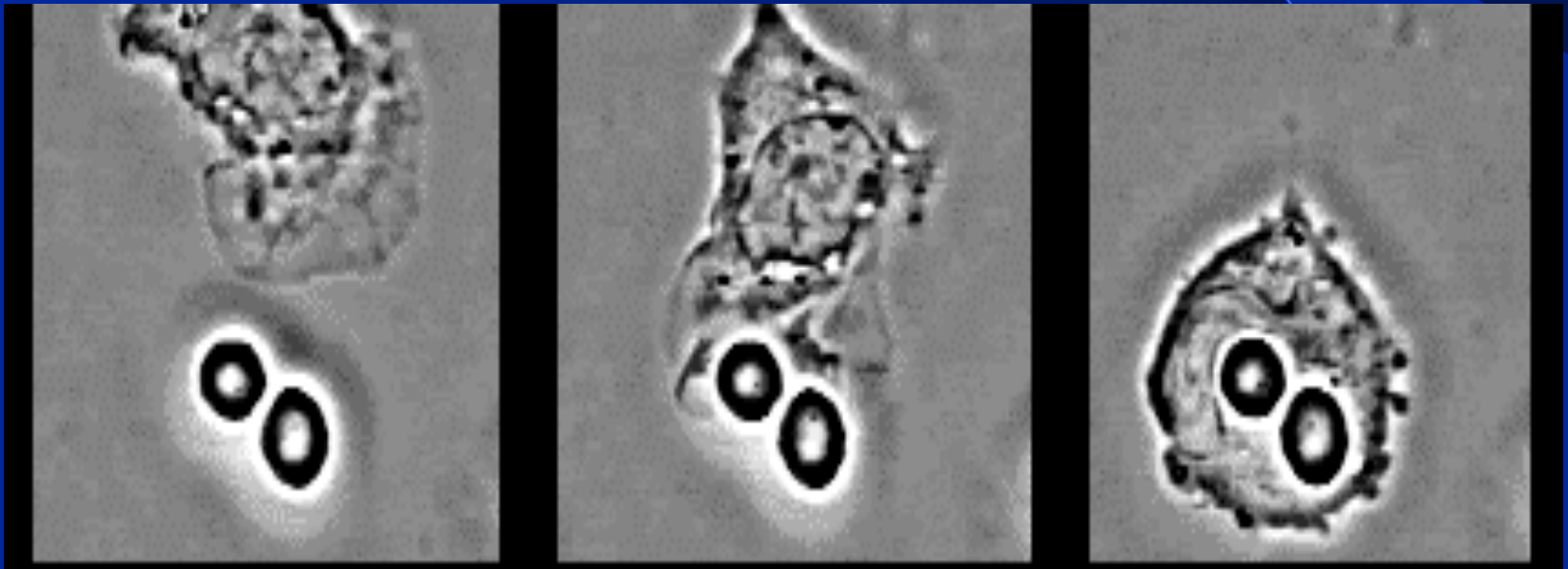
موتروسيات
Bacterial cell
موتروسيات
neutrophils.

→ fibrin.
→ Polysaccharides.

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*.

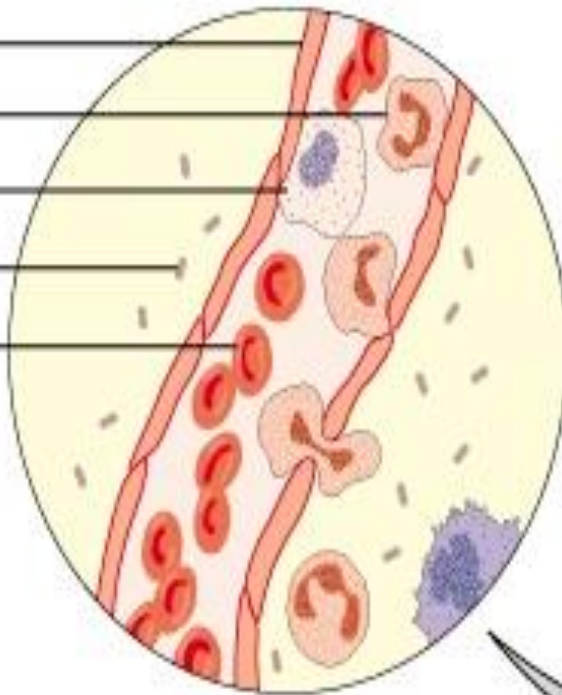
Blood vessel
endothelium

Neutrophil

Monocyte

Bacterium

Erythrocyte

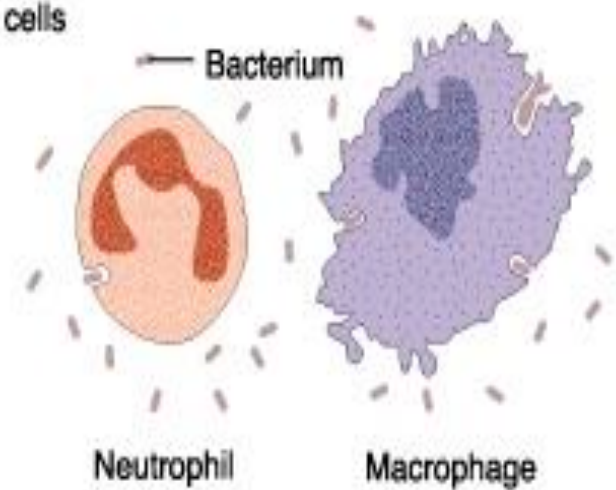


4 Margination—
phagocytes
stick to
endothelium

5 Emigration—
phagocytes
squeeze between
endothelial cells

6 Phagocytosis
of invading
bacteria

Bacterium



Neutrophil

Macrophage

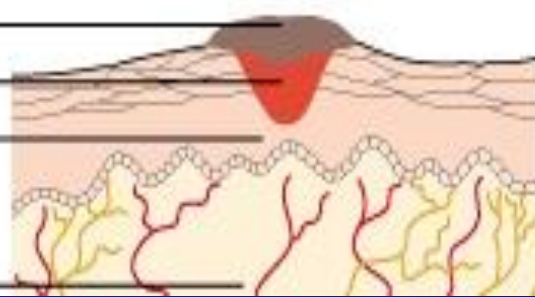
(c) Phagocyte migration and phagocytosis

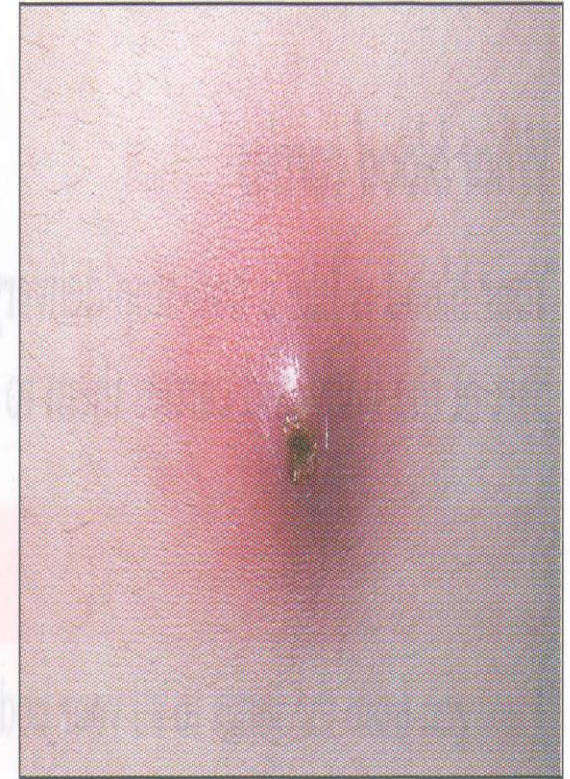
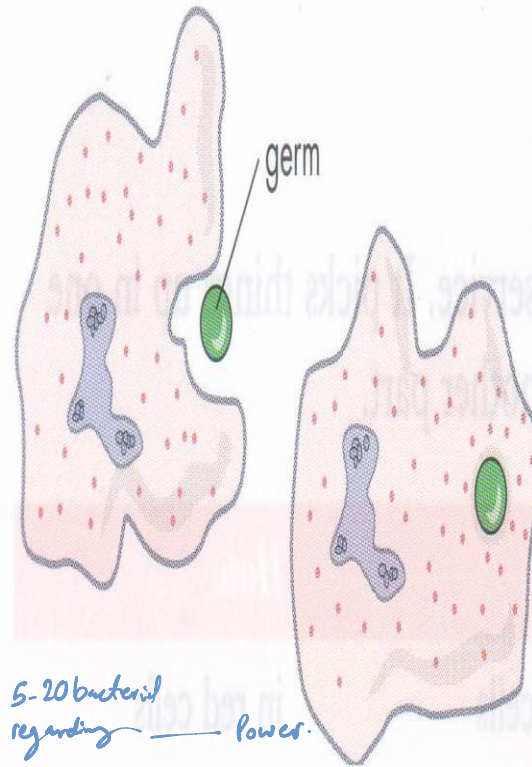
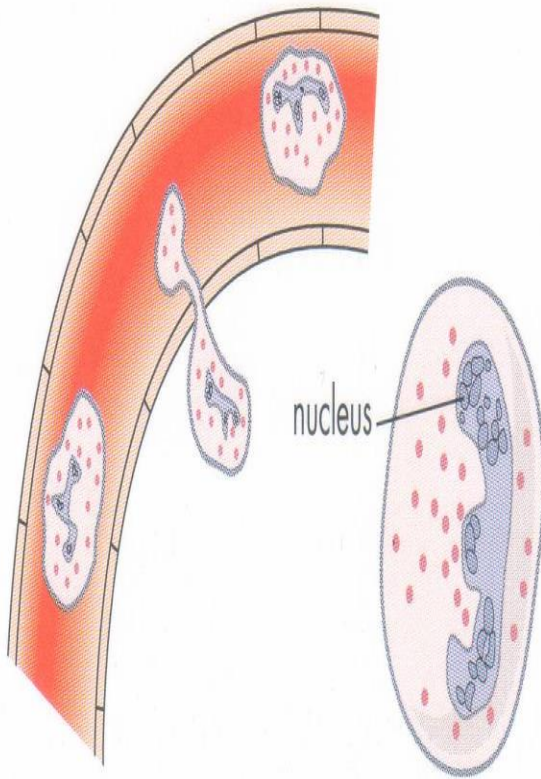
Scab

Blood clot

Regenerated
epidermis
(parenchyma)

Regenerated





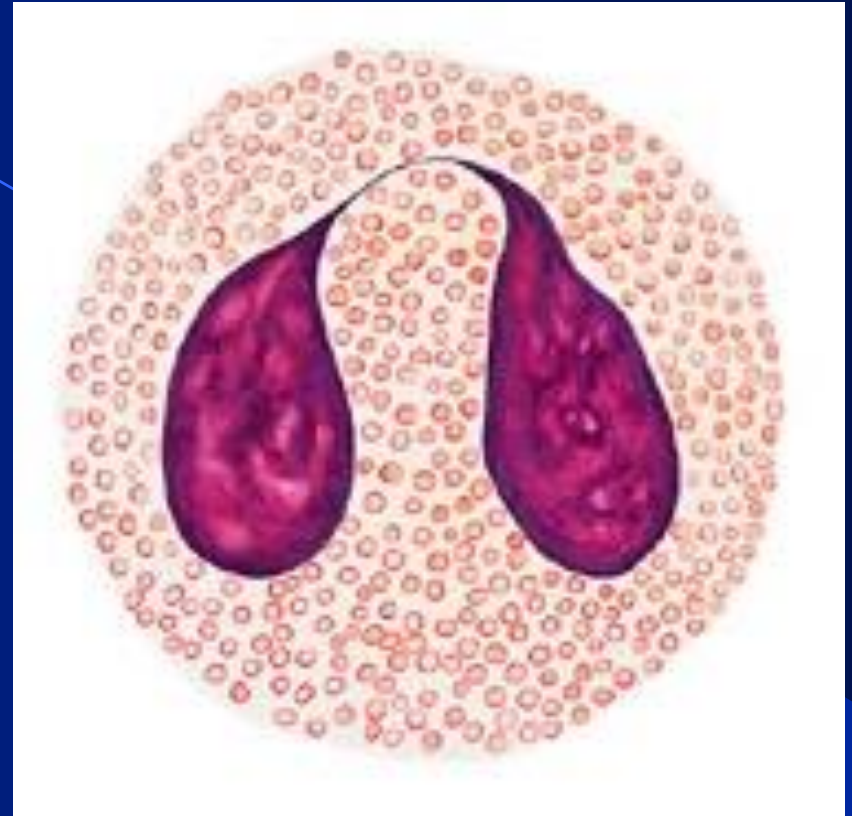
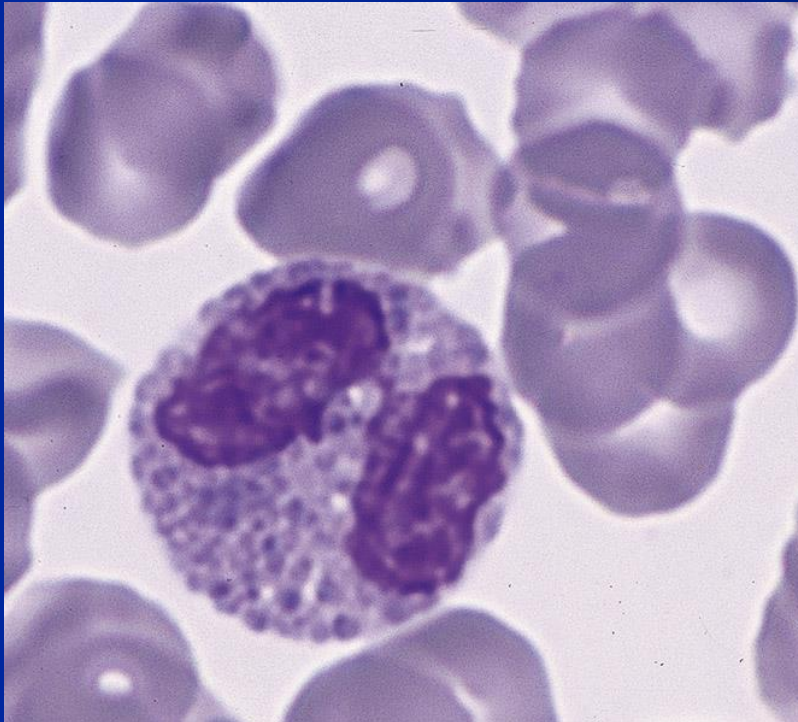
1 The phagocytes pass out through capillary walls and into the infected tissue.

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

*Ag-Ab reaction
2nd attack.*

□ Function

1- They are weak phagocytes

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

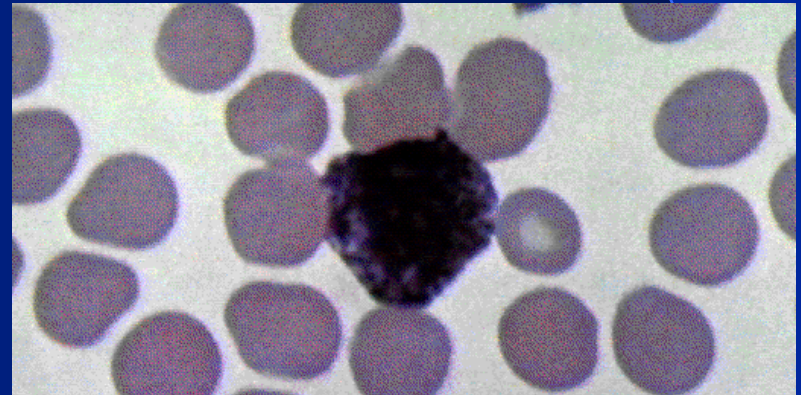
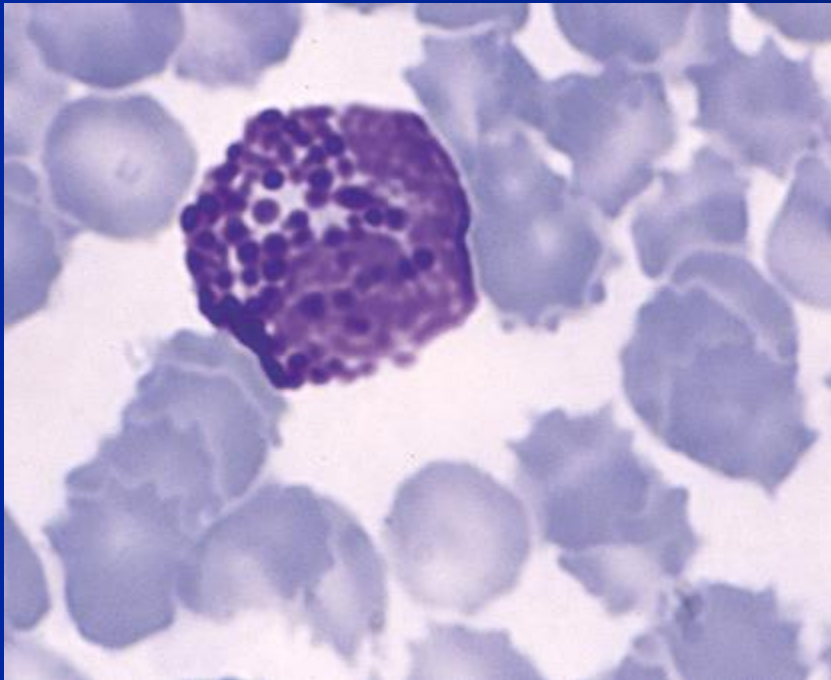
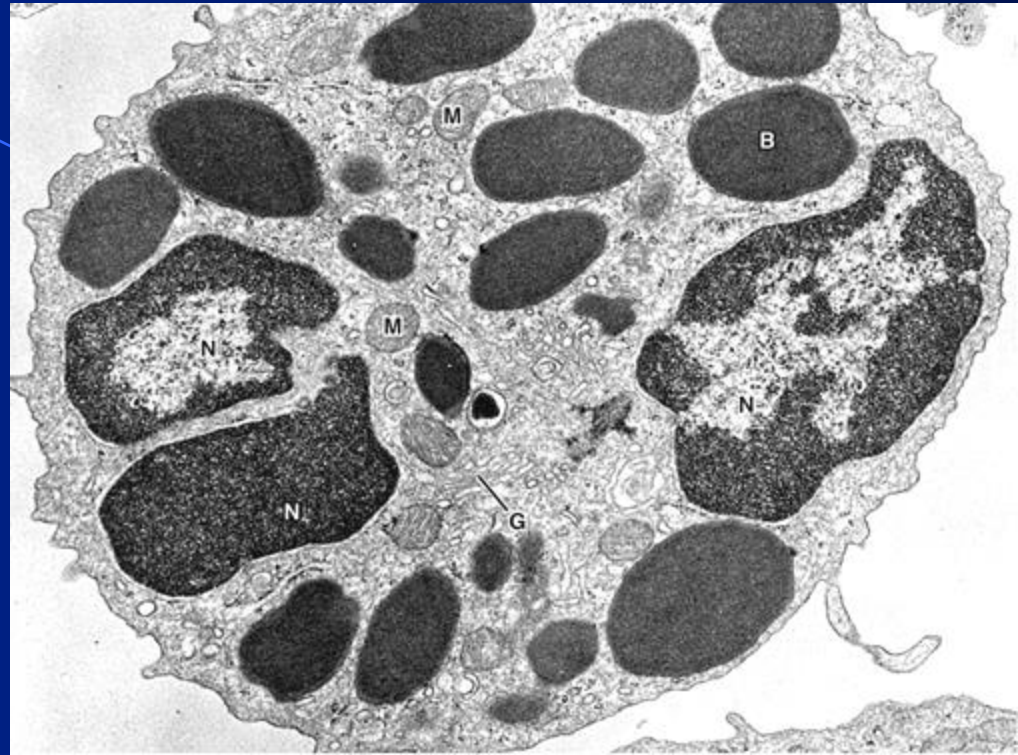
3- They increased in **allergic** conditions by the release of eosinophil chemotactic factor released from the **mast cells** and **basophiles**. Eosinophils phagocytose the antigen-antibody complexes and release substances to neutralize the **histamine**

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

*تسوي حبوب
حاصو-عشان
clot
distinction*

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

Handwritten notes: $\frac{1}{2}$, (red), calling estroplasts.

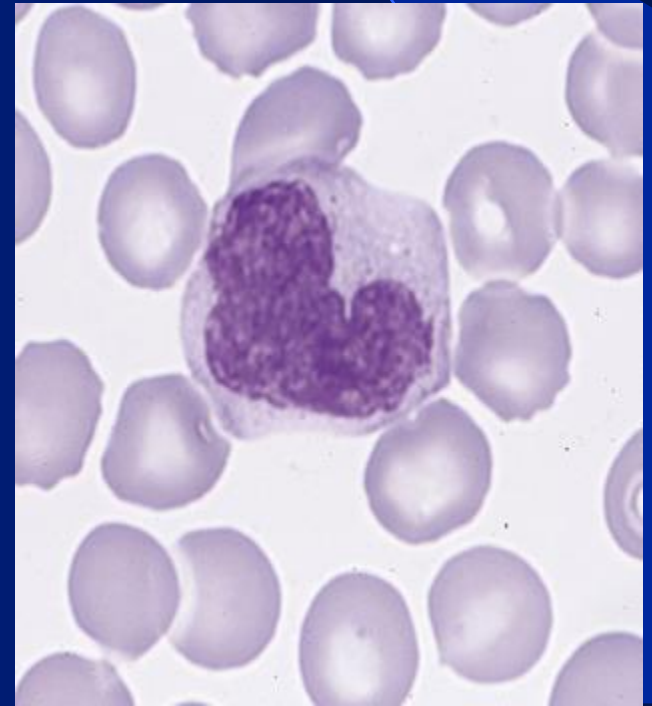
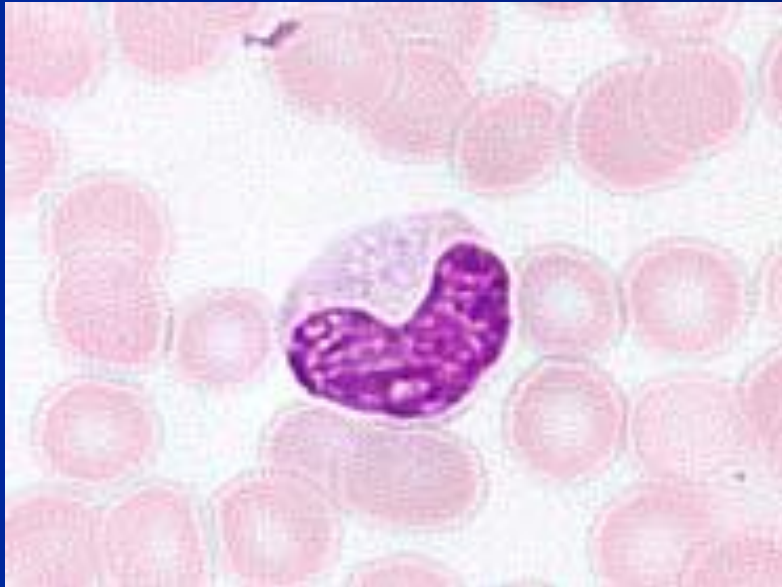
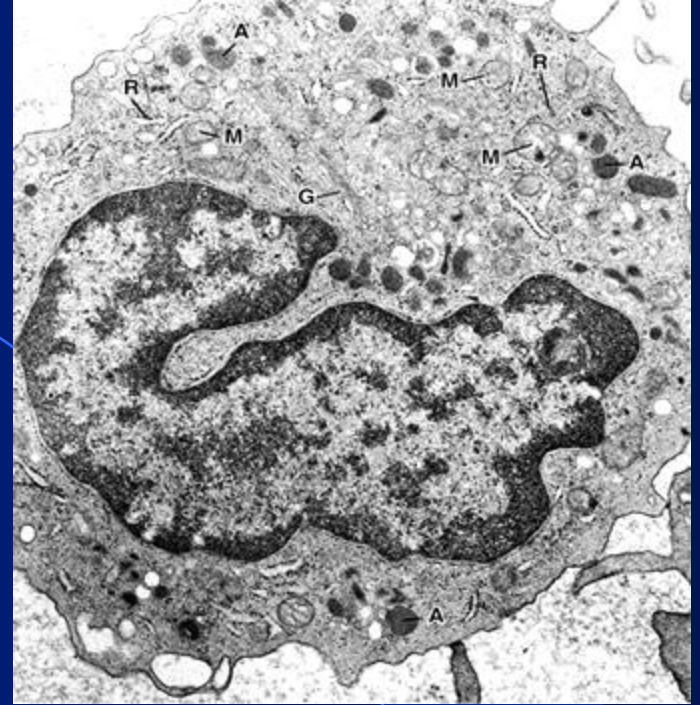
①

②

Monocytes

1. nucleus: oval, horseshoe/kidney shaped, eccentric *بالطرف*
Not central.
2. become wandering macrophages after diapedesis

-Can live up to months.



(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

than neutrophil.

Macrophages help the function of T-and B-lymphocytes by

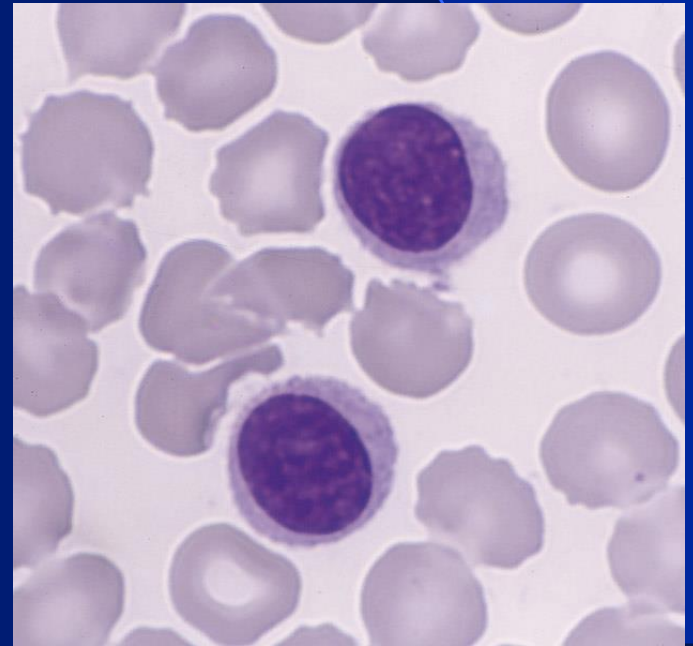
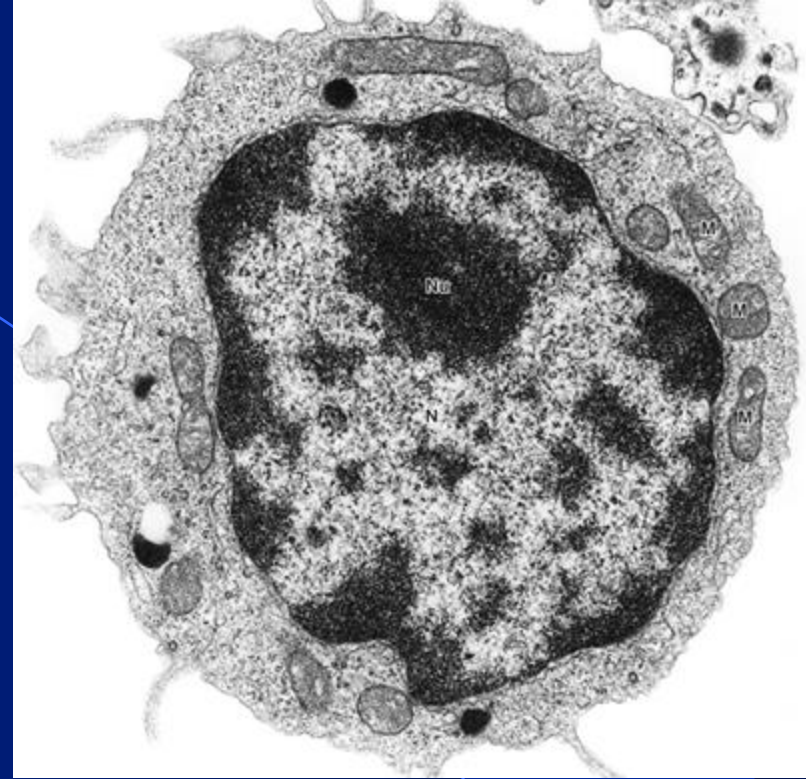
presenting the antigen to these cells *on the surface.*

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

↳ histamines²⁰

Lymphocytes

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



(5) Lymphocytes

□ Characters

*Mostly in lymphatic
tissues not BM.*

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

*ماخوذ من
Cytology.*

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

نَفِيْزٌ بِيْنٌ
Leukemia &
Leucocytosis

□ A- Physiological Leucocytosis

- Increase in number of leucocytes above 11.000/mm³. It occurs in

Can happen
physiological

muscular exercise, emotions, cold bath, cold or hot weather,
pregnancy, labour, pain, anaesthesia and after meals.

Benign condition.

□ B- Pathological Leucocytosis

each increment refer to certain condition

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

قائمة
بجمل
ال
Pathological.

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

الدم
عائلة
نفسه
WBC's
B4
ما
اللحم
خبر

Leukaemia is associated with anemia and bleeding

= not effecent 'not working cell'. tendency due to :

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

Leucopenia

4,000

- 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

B M aplasia: وقت كل functions

2- Some bacterial infections as typhoid fever, **brucellosis**

تبيسه

Chemotherapy

بعضه به بركان tumor شان ما بالجنرال

3- Some viral infections as AIDS, influenza, hepatitis

بعلو B M de pression