

1. NEUTROPHILS



- Characteristics**
- 40–70% of WBCs
 - Nucleus: **2–5 lobes connected by thin chromatin filaments**
 - Granules: small, neutral (faint pink)

Functions (VERY IMPORTANT ⚠)

- 1. Margination**
 - Neutrophils stick to endothelium via **selectins**
- 2. Chemotaxis**
 - Movement toward infection due to:
 - Bacterial toxins
 - Degenerative products
 - Complement system
- 3. Diapedesis**
 - Passage through capillary pores using **integrins**
 - Pores enlarge during inflammation
- 4. Amoeboid Movement**
 - Speed: **40 μm/min**
- 5. Phagocytosis**
 - Engulf bacteria, toxins, dead cells
 - Use:
 - Lysosomal enzymes
 - H₂O₂ (bactericidal)
 - One neutrophil ingests **5–20 bacteria**
 - Dead neutrophils → **pus formation**
- 6. Opsonization**
 - Coating pathogens → easier phagocytosis

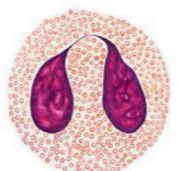
PHAGOCYTOSIS (Inside Neutrophils & Macrophages)

- Lysosomal Enzymes:**
- Acid hydrolases
 - Lysozyme
 - Neutral proteases
 - Myeloperoxidase
 - Lactoferrin
 - Phospholipase A

Function: **Degrade biomolecules & kill pathogens**

- Neutrophilia**
- Infections (bacterial, viral, fungal)
 - Inflammation (e.g. rheumatic fever)
 - Tissue damage (burns, trauma)
 - Malignancy
 - Smoking

2. EOSINOPHILS



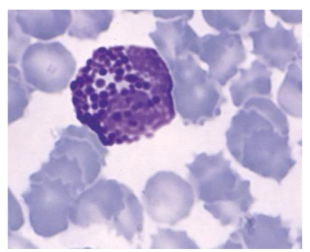
- Characteristics**
- 1–4%
 - **Bilobed nucleus**
 - **Red (eosinophilic) granules**

Functions

1. Weak phagocytes
2. ↑ in **parasitic infections (e.g. Ascaris)**
3. Kill parasites via:
 - Chemotaxis
 - Amoeboid movement
 - Diapedesis
 - Release substances (e.g. **peroxidase**)
4. ↑ in **allergic conditions**
 - Due to eosinophil chemotactic factor from mast cells & basophils
5. Phagocytose **antigen-antibody complexes**
6. Neutralize histamine
7. Produce:
 - **Pro-fibrinolysin** → fibrinolysin
 - → Digests fibrin clot

- Eosinophilia**
- Allergies (asthma, hay fever, skin allergy)
 - Parasitic infections
 - Leukemia

3. BASOPHILS



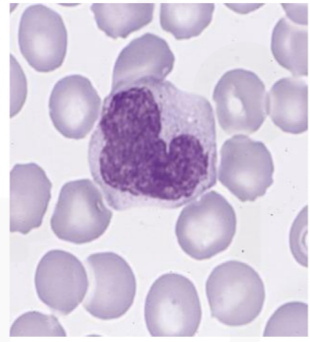
- Characteristics**
- 0–1%
 - **Deep blue granules**
 - **Similar to mast cells**

Functions

- Secrete **heparin** (anticoagulant)
- Release:
 - Histamine
 - Serotonin
 - Bradykinin
 - Lysosomal enzymes
- Cause:
 - Vasodilation
 - Allergic reactions
 - Tissue inflammation

- Basophilia**
- Allergy
 - Leukemia

4. MONOCYTES



- Characteristics**
- 2–8%
 - Nucleus: **oval / kidney / horseshoe-shaped**
 - No specific granules
 - In tissues:
 - Become **macrophages**
 - Cytoplasm filled with lysosomes

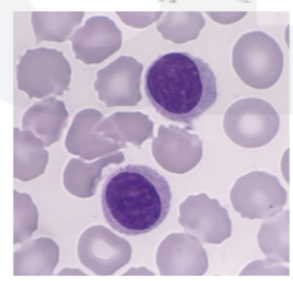
Functions

- Strong **phagocytosis** (more powerful than neutrophils)
- Antigen presentation to:
 - T lymphocytes
 - B lymphocytes
- Release chemicals → enhance:
 - Inflammation
 - Allergic response

- Monocytosis**
- Chronic infections (e.g. tuberculosis)
 - Leukemia

5. LYMPHOCYTES

- Characteristics**
- 20–45%
 - Smallest WBCs
 - Large **rounded nucleus**
 - Scanty cytoplasm



- Lymphocytosis**
- Chronic viral & bacterial infections
 - Leukemia

1. B-Lymphocytes

- → Plasma cells
- Responsible for:
 - Humoral immunity
 - Antibody production

2. T-Lymphocytes

- Mature in thymus
- Responsible for:
 - Cell-mediated immunity

General Information

- Normal count: 4,000 – 11,000 / mm³ in adult males
- Higher in children
- Origin: Bone marrow
- Note:
- T-lymphocytes complete maturation in the thymus
- Although 75% of bone marrow activity produces WBCs, their number is أقل than RBCs because:
- Short life span

LIFE SPAN



Granulocytes

- 4–8 hours in circulation
- 4–5 days in tissues
- Rapid destruction during infection

Monocytes

- 3 days in blood
- enter tissues → become macrophages
- Can live months

Lymphocytes

- Variable life span
- Circulate between:
- Blood
- Lymphatic tissues



CLASSIFICATION OF WBCs

I. Granulocytes

Characteristics:

- Nucleus: >1 lobe
- Contain granules
- Life span: few days

Types:

1. Neutrophils (40–70%)
2. Eosinophils (1–4%)
3. Basophils (0–1%)

II. Agranulocytes (Non-granulocytes)

Characteristics:

- Nucleus: round or horseshoe-shaped
- No specific granules

Types:

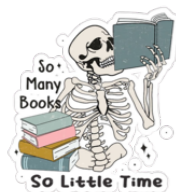
1. Lymphocytes (20–45%)
2. Monocytes (2–8%)

DIFFERENTIAL LEUCOCYTIC COUNT

- Based on presence/absence of granules
- Done by:
- Leishman stain
- Automated machines



LEUCOCYTOSIS (>11,000/mm³)



A. Physiological Causes

- Exercise
- Emotions
- Cold bath
- Hot or cold weather
- Pregnancy
- Labor
- Pain
- Anesthesia
- After meals

B. Pathological Causes

- **Neutrophilia**
 - Infections (bacterial, viral, fungal)
 - Inflammation (e.g. rheumatic fever)
 - Tissue damage (burns, trauma)
 - Malignancy
 - Smoking
- **Eosinophilia**
 - Allergies (asthma, hay fever, skin allergy)
 - Parasitic infections
 - Leukemia
- **Basophilia**
 - Allergy
 - Leukemia
- **Monocytosis**
 - Chronic infections (e.g. tuberculosis)
 - Leukemia
- **Lymphocytosis**
 - Chronic viral & bacterial infections
 - Leukemia

LEUCOPENIA (<4,000/mm³)

Danger:

- Increased risk of infection
- May lead to death

Causes:

1. **Bone marrow depression:**
 - Radiation
 - Chemotherapy
2. **Bacterial infections:**
 - Typhoid
 - Brucellosis
3. **Viral infections:**
 - AIDS
 - Influenza
 - Hepatitis

LEUKEMIA

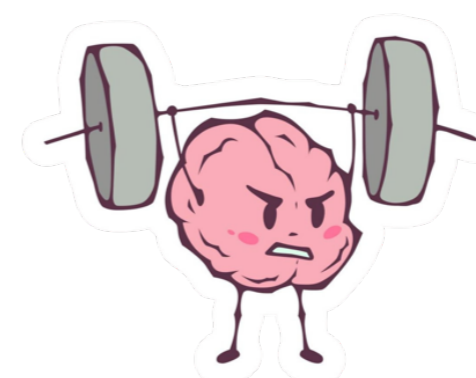
- Malignant disease of bone marrow
- WBC count may reach **500,000/mm³**

Associated with:

- **Anemia**
- **Bleeding tendency**

Cause:

- Decreased bone marrow areas for:
 - RBC production
 - Platelet production



- Neutrophils = first line defense (acute infection)
- Macrophages = stronger + antigen presentation
- Eosinophils = parasites + allergy
- Basophils = histamine → allergy
- Lymphocytes = immunity (B & T)

