LEUKOPOIESIS

LEARNING OBJECTIVES

• To classify the different types of WBCs
• To know the basic structure and function of different types of WBCs
• To understand the formation and maturation of WBCs
• To know the disorders related to WBCs

Leukocytosis

• Leukocytes, the only blood components that are complete cells:
  o Are less numerous than RBCs
  o Make up 1% of the total blood volume
  o Can leave capillaries via diapedesis
• Move through tissue spaces WBC count over 11,000 per cubic millimeter
• Normal response to bacterial or viral invasion

Leuopenia

• Decrease in leukocyte count

classification

• Based on presence/absence of granules in cytoplasm the WBCs are classified into two groups:
  o Granulocytes
    ▪ Neutrophils
    ▪ Eosinophils
    ▪ Basophils
  o Agranulocytes
    ▪ monocytes
    ▪ lymphocytes
Granulocytes

- Comprise of neutrophils, eosinophils, and basophils
- Contain cytoplasmic granules that stain specifically (acidic, basic, or both) with Wright’s stain
- Are larger and usually shorter-lived than RBCs
- Have lobed nuclei
- Are all phagocytic cells

Neutrophils

- Neutrophils have two types of granules that:
  - Take up both acidic and basic dyes
  - Give the cytoplasm a lilac color
  - Contain peroxidases, hydrolytic enzymes, and defensins (antibiotic-like proteins)
- Are the first line of body defense mechanism

Neutorphils

- Nucleus looks like sausage links – multilobed
- Account for 50% of WBCs - 3,000 to 7,000/cc
- Life span - 6 hrs – few days
- Phagocytize bacteria

Eosinophils

- Account for 1–4% of WBCs
- Have red-staining, bilobed nuclei connected via a broad band of nuclear material
- Have red to crimson (acidophilic)

Basophils
Agranulocytes

- Account for 0.5% of WBCs and:
- Have U- or S-shaped nuclei with two or three conspicuous constrictions
- Are functionally similar to mast cells
- Have large, purplish-black (basophilic)

Lymphocytes

- Account for 25% or more of WBCs and:
- Have large, dark-purple, circular nuclei with a thin rim of blue cytoplasm
- Are found mostly enmeshed in lymphoid tissue (some circulate in the blood)

Types of lymphocytes

- There are two types of lymphocytes: T cells and B cells
- T cells function in the cell mediated immune response
- B cells give rise to plasma cells, which produce antibodies

Monocytes

- They are the largest leukocytes
- They have abundant pale-blue cytoplasms
- They have purple-staining, U- or kidney-shaped nuclei
They leave the circulation, enter tissue, and differentiate into macrophages

**Macrophages**
- Are highly mobile and actively phagocytic
- Activate lymphocytes to mount an immune response

**Blood Cells Formation**
- Erythropoiesis: Formation of RBC (erythrocytes)
- Leucopoiesis: Formation of WBC (leucocytes)
- Thrombopoiesis: Formation of platelets (thrombocytes)
- All WBC’s are produced from PPSC by a process called leucopoiesis.
- WBC’s are produced in red bone marrow and may remain there until needed in the body
- They may migrate to other organs for further differentiation

**Leukopoiesis**
- Is hormonally stimulated by two families of cytokines (hematopoietic factors) – interleukins and colony-stimulating factors (CSFs)
- Interleukins are numbered (e.g., IL-1, IL-2), whereas CSFs are named for the WBCs they stimulate (e.g., granulocyte-CSF/G-CSF stimulates
granulocytes. Others are Monocyte-CSF and Granulocyte-Monocyte CSF
• Macrophages and T cells are the most important sources of cytokines
• Many hematopoietic hormones are used clinically to stimulate bone marrow

**Formation of Leukocytes**

• All leukocytes originate from hemocytoblasts
• Hemocytoblasts differentiate into myeloid stem cells and lymphoid stem cells
• Myeloid stem cells become myeloblasts or monoblasts
• Lymphoid stem cells become lymphoblasts
• Myeloblasts develop into eosinophils, neutrophils, and basophils
• Monoblasts develop into monocytes
• Lymphoblasts develop into lymphocytes

**Leukemia**

• Leukemia refers to cancerous conditions involving white blood cells
• Leukemias are named according to the abnormal white blood cells involved
  o Myelocytic leukemia – involves myeloblasts
  o Lymphocytic leukemia – involves lymphocytes
• Acute leukemia involves blast-type cells and primarily affects children
• Chronic leukemia is more prevalent in older people
• Immature white blood cells are found in the bloodstream in all leukemias
• Bone marrow becomes totally occupied with cancerous leukocytes
• The white blood cells produced, though numerous, are not functional
• Death is caused by internal hemorrhage and overwhelming infections
Treatment

- include irradiation, antileukemic drugs, and bone marrow transplants