Hematology Alterations:
Altered Leukocyte Function
Altered Lymphoid Function

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Alterations in Leukocyte Function

- **Quantitative**
  - Decreased production in bone marrow
  - Accelerated destruction of circulating WBC
  - Response to infections

- **Qualitative**
  - Disruption in function
    - ↓ phagocytosis: granulocytes, monocytes, macrophages
    - ↓ antigen response: lymphocytes
    - Infectious mononucleosis
    - Cancer: leukemia, myeloma
Quantitative Alterations

- **-cytosis:** \( \uparrow \) WBC count (>10,000/mm\(^3\))
- **-philia:** \( \uparrow \) WBC count
- **-penia:** \( \downarrow \) WBC count (<3,500/mm\(^3\))

**Leukocytosis**
- Normal response to physiologic stress

**Leukopenia**
- \( \uparrow \) infection risk
- Endogenous or exogenous causes
Leukocyte Development

Hemocytoblast

Myeloblast

Monoblast

Lymphoblast

Progranulocyte

Monocyte

Agranulocytes

Basophilic Myelocyte

Eosinophilic Myelocyte

Neutrophilic Myelocyte

Basophil

Eosinophil

Neutrophil

Granulocytes

Agranulocytes

Monocyte

Lymphocyte

...
Granulocytes

- **Neutrophilia**
  - Early stages of infection or inflammation

- **Neutropenia**
  - Severe prolonged infections
  - Absence of infection:
    - ↓ neutrophil production
    - ↓ neutrophil survival
    - Abnormal neutrophil distribution/sequestration
Granulocytes

- Neutropenia
  - Primary Congenital
    - Immunodeficiencies – ↓ neutrophil production
  - Primary Acquired
    - Hematologic disorders
    - Anorexia/starvation
  - Secondary
    - Malignancies
    - Chemotherapy
    - Immunosuppressive drugs
Granulocytes

- Eosinophilia
  - Allergic disorders
  - Parasitic infections
  - ↑ Tryptophan ingestion
  - Fibromyalgia Syndrome

- Eosinopenia
  - Migration of eosinophils to inflammatory site
  - Hypercortisol secretion (Cushing syndrome)
- Basophilia
  - Inflammation
  - Immediate hypersensitivity reactions
  - Myeloproliferative disorders

- Basopenenia (basophilic leukopenia)
  - Hyperthyroidism
  - Acute infections
  - Hypercortisol (exogenous)
  - Ovulation/pregnancy
Monocytosis
- Bacterial infections
- Chronic infections
- Myocardial damage (MI)

Monocytopenia
- Rare
Agranulocytes  Lymphocytes

- **Lymphocytosis**
  - Acute viral infections – Epstein-Barr
  - Rare in bacterial infections

- **Lymphocytopenia**
  - Altered lymphocyte production
    - Neoplasms
    - Immune deficiencies
  - Lymphocyte destruction
    - Drugs, radiation
    - Viruses, HIV
    - Autoimmune

Other Conditions Associated with Leukophiliases & Leukopenias

Table 29-1
Infectious Mononucleosis

- Infection of B-lymphocytes
- Acute, self-limiting
- Transmission
  - Saliva (personal contact)
  - Incubation: 30-50 days
  - 85% of cases - Epstein-Barr virus
    - B cells have an EBV receptor site
  - Other viral causes:
    - Cytomegalovirus (CMV), hepatitis, influenza, HIV
Infectious Mononucleosis

Signs and symptoms:
- Fever
- Sore throat
- Cervical lymphadenopathy
- ↑ lymphocyte count
- Atypical lymphocytes

Serious complications are infrequent (<5%)
- Splenic rupture is the most common cause of death
Leukemia

Characteristics

- Malignant disorder of the lymphocytes and blood-forming organs
- Excessive accumulation of malignant leukocytes
- Overcrowding of bone marrow
- ↓ production of normal hematopoietic cells
Leukemias

- Acute leukemia
  - Presence of undifferentiated or immature cells, usually blast cells

- Acute lymphocytic leukemia (ALL)
  - > 30% lymphoblasts in bone marrow or blood
    - Children
      - Mean age = 13
      - >95% of children have remission
    - Adults
      - 20% of ALL cases
      - Greater mortality than children
Leukemias

- **Acute myelogenous leukemia (AML)**
  - **Causes:**
    - Abnormal proliferation of myeloid precursor cells
    - ↓ Apoptosis
    - Loss of cellular differentiation
  - **Pathophysiology**
    - Leukocytosis
    - Predominance of blast cells
  - **Occurrence**
    - Adults – mean age 67
Leukemias

- Chronic leukemia
  - Predominant cell is mature but does not function normally
  - 30% of leukemia cases

- Chronic lymphocytic leukemia (CLL)
  - Pathophysiology
    - Malignant transformation and Slow ↑B lymphocytes
    - Cancerous cells spread from the bone marrow to the blood
    - Involves lymph nodes
  - Occurrence
    - Adults > 50
Leukemias

- **Chronic myelogenous leukemia (CML)**
  - **Definition**
    - ↑ myeloid cell production in bone marrow
  - **Causes**
    - Philadelphia chromosomes
      - Translocation of chromosomes 9 and 22
      - Found in the affected WBC
      - Allows uncontrollable cell growth
    - High dose radiation treatments
  - **Occurrence**
    - Children and middle-age adults.
Clinical manifestations

- Systemic
  - Weight loss
  - Fever
  - Frequent infections

- Psychological
  - Fatigue
  - Loss of appetite

- Lymph nodes
  - Swelling

- Spleen and/or liver
  - Enlargement

- Muscular
  - Weakness

- Skin
  - Night sweats
  - Easy bleeding and bruising
  - Purplish patches or spots

- Bones or joints
  - Pain or tenderness
Myeloma

- Proliferation of hematopoietic cells (bone marrow)
- Solitary or multifocal tumors (multiple myeloma)
- Malignant plasma cells produce abnormally large amounts immunoglobulin (Bence-Jones proteins)
  - Pass through the glomerulus and damage renal tubular cells
Myeloma

- Multiple myeloma causes increased osteoclastic bone destruction

Clinical manifestations
- Cortical (outer) and medullary (inner) bone loss
- Skeletal pain
- Recurring infections - ↓ humoral immune response
Lymphadenopathy

- Enlarged lymph nodes that become palpable and tender

- Local lymphadenopathy
  - Drainage of an inflammatory lesion located near the enlarged node

- General lymphadenopathy
  - Malignant or nonmalignant disease
Malignant Lymphomas

- Proliferation of malignant lymphocytes in lymphoid system.

- Hodgkin lymphoma
  - Reed-Sternberg cells in the lymph nodes
    - Large, multinucleated or bilobular nucleus
    - Adenopathy, mediastinal mass, splenomegaly, and abdominal mass
    - Prognosis good
  - Occurrence
    - Both children and adults
      - Early adulthood (ages 15 to 40, especially in a person’s 20s)
      - Late adulthood (after age 55).
Malignant Lymphomas

- Non-Hodgkin lymphomas
  - **Types**
    - B-cells
    - T-cells
    - Slow-growing
    - Fast-growing
  - **Occurrence**
    - Equal in males and females
    - 95% in adults
Alteration in Platelet Function

- **Thrombocytopenia**
  - Platelet count < 150,000 platelets/mm³

- **Causes:**
  - ↓ platelet production in bone marrow
  - ↑ breakdown intravascular platelets
  - ↑ breakdown of extravascular platelets in spleen or liver
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