Chapter 28
Drugs for Hematopoietic Disorders

Hematopoiesis

- Process of blood-cell formation
- Begins with stem cells in bone marrow
- Homeostatic control maintained by hormones and growth factors
  - Demands of body affect hematopoiesis
    - White blood cells (WBCs) can increase concentration up to ten times normal
    - Red blood cells (RBCs) can increase up concentration up to five times normal

Regulation of Hematopoiesis

- Messages from hormones
- Hematopoietic growth factors
  - Recombinant DNA technology
  - Used pharmacologically to stimulate production of erythrocytes, leukocytes, platelets

Erythropoietin

- Hormone that stimulates red-blood-cell production
  - Secreted when kidneys sense reduction in oxygen
  - Body experiences hypoxia or hemorrhage
**Synthetic Forms of Erythropoietin**
- Epoetin alpha
- Darbepoietin alpha

**Colony-Stimulating Factors**
- Leukopoiesis is control of WBC production

**Colony-Stimulating Factors (continued)**
- Two categories of growth factors
  - Interleukins modulate immune system
  - Colony-stimulating factors stimulate production of leukocytes.
    - Reduce duration of neutropenia associated with chemotherapy or organ transplant

**CSF Medications**
- Filgrastim (Neupogen): treats neutropenia
- Sargramostim (leukine): treats non-Hodgkin's lymphoma
- Both used to increase leukocyte levels and decrease incidence of infection

**Platelet Enhancers**
- Stimulate activity of megakaryocytes and thrombopoietin
- Increase production of platelets
- Oprelvekin: only drug in this class
  - Prescribed for clients with thrombocytopenia

**How Colony-Stimulating Factors Are Named**
- According to type of blood cell stimulated
  - Granulocyte CSF (G-CSF) increases production of neutrophils
  - Granulocyte/macrophage CSF (GM-CSF) stimulates production of both neutrophils and macrophages
- Research into colony-stimulating factors is emerging area of pharmacology
Anemias

- Blood has reduced capacity to carry oxygen
  - Hemorrhage
  - Excessive erythrocyte destruction
  - Insufficient erythrocyte synthesis
- Anemia is a sign, not a distinct disease

Common Signs and Symptoms

- Pallor of skin and mucous membranes
- Decreased exercise tolerance
- Fatigue and lethargy, dizziness and fainting
- Increased respiratory rate and heart rate
- Heart failure

Antianemic Agents

- Vitamins and minerals given to combat anemia
- Most common are cyanocobalamin, folic acid, and ferrous sulfate

Intrinsic Factor

- Protein secreted by stomach cells
- Required for vitamin $B_{12}$ metabolism
- Lack of intrinsic factor leads to $B_{12}$ deficiency
  - Inflammatory disease of stomach
  - Surgical removal of stomach
  - Strict vegetarian diet

Intrinsic Factor (continued)

- Vitamins and minerals can be given
  - Enhance oxygen-carrying capacity of blood

Figure 28.2 Metabolism of vitamin $B_{12}$
Pernicious Anemia

- Vitamin B₁₂ or folic-acid deficiency
  - Treat with cyanocobalamin
  - Can reverse symptoms of pernicious anemia but nervous system damage may be permanent
  - Folic-acid deficiency during pregnancy linked to neural-tube defects
  - Most common cause of folic-acid deficiency: lack of sufficient dietary intake
  - Chronic alcoholism, fad diets, absorption diseases

Iron Deficiency

- Most common cause of nutritional anemia
- Can be successfully treated with iron supplements
- Caused by
  - Acute or chronic blood loss, peptic ulcer
  - Heavy menstruation, pregnancy, intensive athletic training

Iron

- Essential for metabolism and energy
- Free iron toxic, so body binds it to protein complexes
  - Ferritin and hemosiderin—maintain iron inside cells
  - Transferrin—transports iron to other body sites

Role of the Nurse

- Careful monitoring of client’s condition
- Providing education as it relates to prescribed drug treatment
- Assess medical, drug, dietary, and lifestyle history
- Obtain baseline complete blood count and vital signs

Hematopoietic Growth Factor Therapy

- Assess for food or drug allergies, especially for protein-based products
- Assess for hypertension
- This drug increases risk of thromboembolic disease
- Monitor for side effects
- Give preservative-free formulation to premature infants

Hematopoietic Growth Factor Therapy (continued)

- Use with caution in pregnant and lactating clients (pregnancy category C)
- Client teaching should include
  - Monitoring blood pressure, taking drug as directed
  - Using appropriate injection technique, reporting side effects
Colony-Stimulating Factors

- Assess for contraindications
- Do not administer simultaneously with chemotherapy
- Obtain baseline CBC to evaluate effectiveness
- Monitor for dysrhythmias and tachycardia

Colony-Stimulating Factors (continued)

- Assess for hypertension, skeletal pain, abnormal ST-segment depression
- Use with caution in clients with kidney and liver impairment
- Monitor for respiratory distress
- Teach client how to avoid infections and to report adverse symptoms

Platelet Enhancers

- Use caution with clients with cardiac disease
- Withhold oprelvekin for 12 hours before or after radiation therapy
- Monitor clients with history of edema

Platelet Enhancers (continued)

- Teach client to immediately report
  - Edema; change in urinary output or body weight
  - Bleeding; difficulty breathing
- Client should avoid activities that may produce injury

Antianemic Agents—Vitamin B₁₂ and Folic Acid

- Assess for causes of anemia
- Not an effective treatment for iron-deficiency anemias
- Monitor respiratory and cardiac status closely

Antianemic Agents—Vitamin B₁₂ and Folic Acid (continued)

- Monitor potassium levels
- Assess for itching, rash, flushing
- Stress importance of diet, rest, and reporting shortness of breath or edema
Antianemic Agents—Iron

• Oral, intramuscular, or intravenous administration
• Assess for allergies using a test dose
• May cause gastrointestinal disturbance
• May turn stools dark green or black color

Antianemic Agents—Iron (continued)

• Taking with food reduces GI distress but reduces absorption
• Iron deficiencies common in young children; also monitor for overdose
• Pregnant women and those with heavy menstrual flow have increased demand

Antianemic Agents—Iron (continued)

• Client teaching
  – Take iron with food
  – Use straw to prevent staining teeth
  – Report signs of bleeding

Hematopoietic Growth Factor

• Prototype drug: erythropoietin, epoetin alpha (Epogen, Procrit)
• Mechanism of action: hormone secreted by kidneys, sends message to bone marrow to increase erythrocyte production
• Primary use: treatment of anemia
• Adverse effects: hypertension, seizures

Epoetin Alfa Animation

Click here to view an animation on the topic of epoetin alfa.

Colony-Stimulating Factor

• Prototype drug: filgrastim (Neupogen)
• Mechanism of action: to increase neutrophil production, enhance phagocytosis and cytotoxic functions
• Primary use: chemotherapy, organ transplant, AIDS complications
• Adverse effects: bone pain, allergies, thrombocytopenia
Antianemic Agent—Vitamin Supplement

• **Prototype drug:** cyanocobalamin (Crystamine, vitamin B12, others)
• **Mechanism of action:** to replace vitamin B12
• **Primary use:** treatment of vitamin B12 deficiency
• **Adverse effects:** diarrhea, hypokalemia, rash, anaphylaxis

Antianemic Agent—Iron Supplement

• **Prototype drug:** ferrous sulfate (Feosol, others)
• **Mechanism of action:** to supplement iron needed by body
• **Primary use:** to treat iron deficiency
• **Adverse effects:**
  – Nausea, heartburn, constipation, dark stools
  – Cardiovascular collapse, aggravation of peptic ulcers or ulcerative colitis
  – Hepatic necrosis, anaphylaxis (iron dextran)

Hematopoietic Growth Factors

• Natural hormones that promote some aspect of blood formation
• Several used pharmacologically to stimulate erythrocyte, leukocyte, or platelet production

Antianemic Agents

• Enhance oxygen-carrying capacity of blood
• Most common: cyanocobalamin (Crystamine, others), folic acid (Folvite, others), ferrous sulfate (Feosol)

Clients Receiving Epoetin Alpha

• Assessment
  – Obtain complete health history
  – Assess reason for drug administration
  – Assess vital signs, especially blood pressure.
  – Assess CBC, specifically hematocrit and hemoglobin

Clients Receiving Epoetin Alpha (continued)

• Nursing diagnoses
  – Risk for imbalanced nutrition
  – Risk for impaired gas exchange
  – Risk for injury (weakness, dizziness, syncope)
  – Knowledge Deficit, related to drug therapy
Clients Receiving Epoetin Alpha
(continued)

• Planning
  – Client will
    • Exhibit increase in hematocrit level
    • Show improvement in anemia-related symptoms
    • Demonstrate an understanding of drug’s action by accurately describing drug side effects and precautions
    • Immediately report significant side effects such as gastrointestinal distress

• Implementation
  – Monitor vital signs, especially blood pressure
  – Monitor for seizures and symptoms of other neurologic events
  – Monitor client’s ability to self-administer medication

• Implementation (continued)
  – Monitor laboratory values such as hematocrit and hemoglobin
  – Monitor client for signs of thrombus and other cardiovascular events
  – Monitor dietary intake, ensure adequate intake of all essential nutrients

• Evaluation
  – Client exhibits increase in hematocrit level, improvement in anemia-related symptoms
  – Client reports adverse effects, such as severe headache, chest pain, confusion, numbness, loss of movement in extremity
  – Client verbalizes understanding of drug’s action by describing drug side effects and precautions

Clients Receiving Filgrastim (Neupogen)

• Assessment
  – Obtain complete health history
  – Assess reason for drug administration
  – Assess vital signs and complete blood count

• Nursing diagnoses
  – Risk for infection, related to impaired immune defense
  – Risk for injury, related to side effects of drug therapy
  – Knowledge deficit, related to drug therapy
Clients Receiving Filgrastim (Neupogen) (continued)

• Planning
  – Client will
    • Experience increase in leukocyte levels, decrease in incidence of infection
    • Demonstrate understanding of drug’s action
    • Immediately report significant adverse effects

• Implementation
  – Monitor vital signs
  – Monitor for signs and symptoms of infection
  – Monitor CBC with differential

• Evaluation
  – Client
    • Exhibits increase in leukocyte levels, decrease in incidence of infection
    • Demonstrates understanding of drug’s action
    • Reports adverse effects

Clients Receiving Ferrous Sulfate (Ferralyn)

• Assessment
  – Obtain complete health history
  – Assess reason for drug administration
  – Assess CBC, specifically hematocrit and hemoglobin levels

• Nursing diagnoses
  – Risk for imbalanced nutrition
  – Risk for impaired gas exchange
  – Risk for injury (weakness, dizziness, syncope)
  – Knowledge deficit related to drug therapy
Clients Receiving Ferrous Sulfate (Ferralyn) (continued)

- **Planning**
  - Client should
    - Exhibit increase in hematocrit level, improvement in anemia-related symptoms
    - Demonstrate understanding of drug's action
    - Verbalize importance of reporting significant side effects

- **Implementation**
  - Monitor CBC, changes in stool
  - Plan activities; allow for periods of rest
  - Administer medication on empty stomach
  - Administer liquid-iron preparations through straw or place on back of tongue
  - Encourage adequate intake of foods high in iron
  - Monitor for potential for child's access to medication

- **Evaluation**
  - Client will
    - Exhibit increase in hematocrit level, improvement in anemia-related symptoms
    - Demonstrate understanding of drug's action
    - Verbalize importance of reporting significant side effects

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**Table 28.1 Hematopoietic Growth Factors**

**Table 28.3 Antianemic Agents**