Hematologic System, Oncologic Disorders & Anemias

Hematology

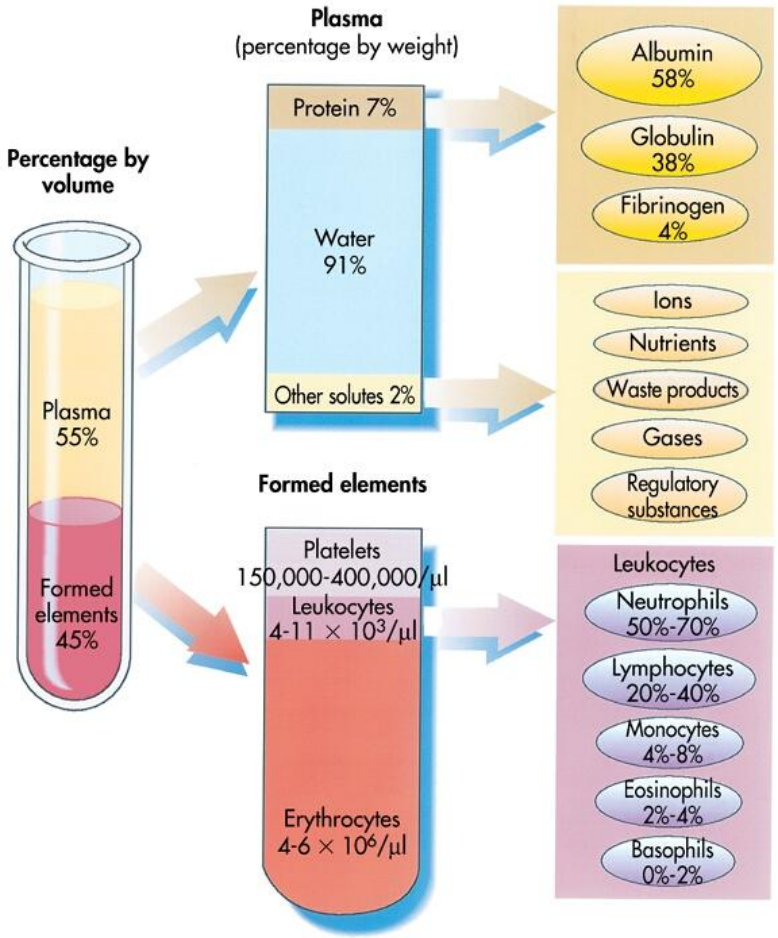
- Study of blood and blood forming tissues
- Key components of hematologic system are:
  - Blood
  - Blood forming tissues
    - Bone marrow
    - Spleen
    - Lymph system

What Does Blood Do?

- Transportation
  - Oxygen
  - Nutrients
  - Hormones
  - Waste Products
- Regulation
  - Fluid, electrolyte
  - Acid-Base balance
- Protection
  - Coagulation
  - Fight Infections

Components of Blood

- Plasma
  - 55%
- Blood Cells
  - 45%
  - Three types
    - Erythrocytes/RBCs
    - Leukocytes/WBCs
    - Thrombocytes/Platelets



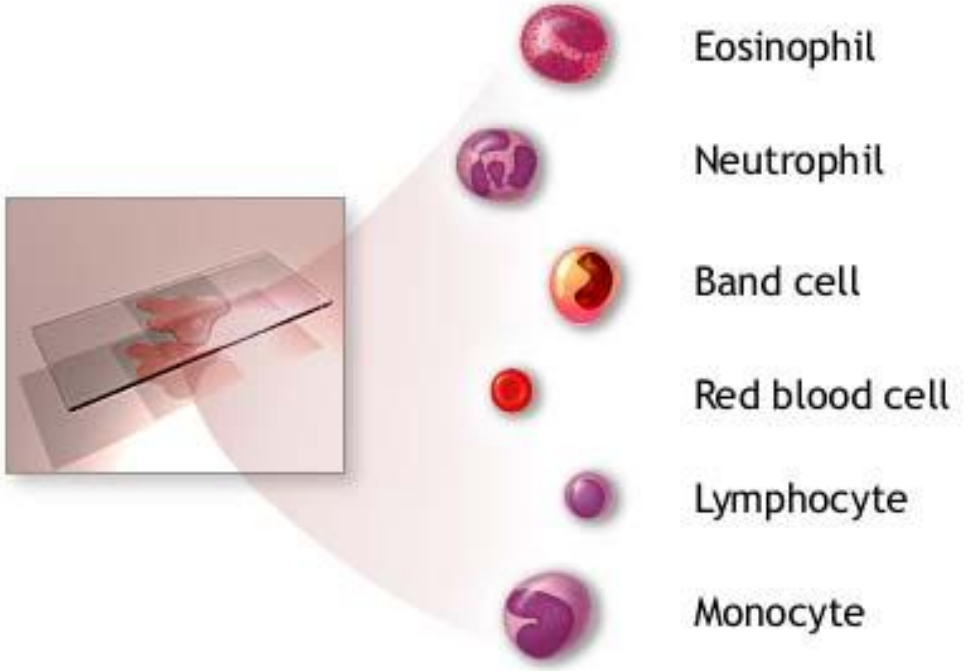
From Thibodeau GA, Patton KT: *The human body in health and disease*, ed 3, St. Louis, 2002, Mosby.

Erythrocytes/Red Blood Cells

- Composed of hemoglobin
- *Erythropoiesis*
  - = RBC production
    - Stimulated by hypoxia
    - Controlled by *erythropoietin*
      - Hormone synthesized in kidney
- *Hemolysis*
  - = destruction of RBCs
  - Releases bilirubin into blood stream
  - Normal lifespan of RBC = 120 days

Leukocytes/White Blood Cells

- 5 types
  - Basophils
  - Eosinophils
  - Neutrophils
  - Monocytes
  - Lymphocytes



Types and Functions of Leukocytes

TYPE	CELL FUNCTION
Granulocytes	
Neutrophil	Phagocytosis, early phase of inflammation
Eosinophil	Phagocytosis, parasitic infections
Basophil	Inflammatory response, allergic response
Agranulocytes	
Lymphocyte	Cellular, humoral immune response
Monocyte	Phagocytosis; cellular immune response

Thrombocytes/Platelets

- Must be present for clotting to occur
- Involved in hemostasis

Normal Clotting Mechanisms

- Hemostasis
  - Goal: Minimizing blood loss when injured
    1. Vascular Response
       - vasoconstriction
    2. Platelet response
       - Activated during injury
       - Form clumps (agglutination)
    3. Plasma Clotting Factors
       - Factors I – XIII
       - Intrinsic pathway
       - Extrinsic pathway

Anticoagulation

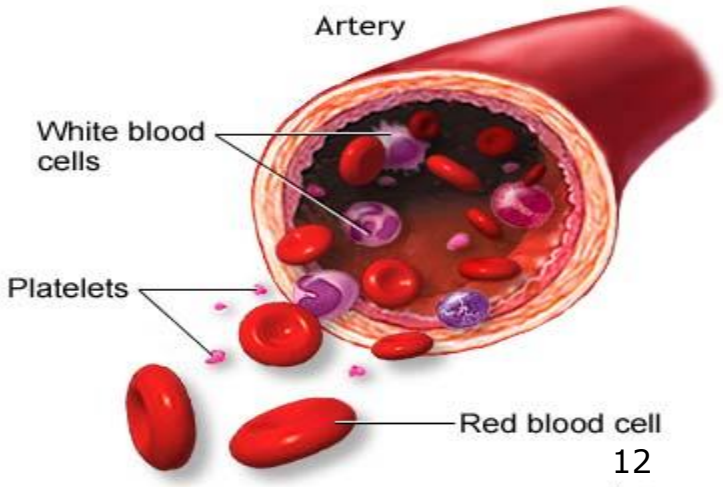
- Elements that interfere with blood clotting
- Countermechanism to blood clotting—keeps blood liquid and able to flow

Structures of the Hematologic System

- Bone Marrow
- Liver
- Lymph System

Bone Marrow

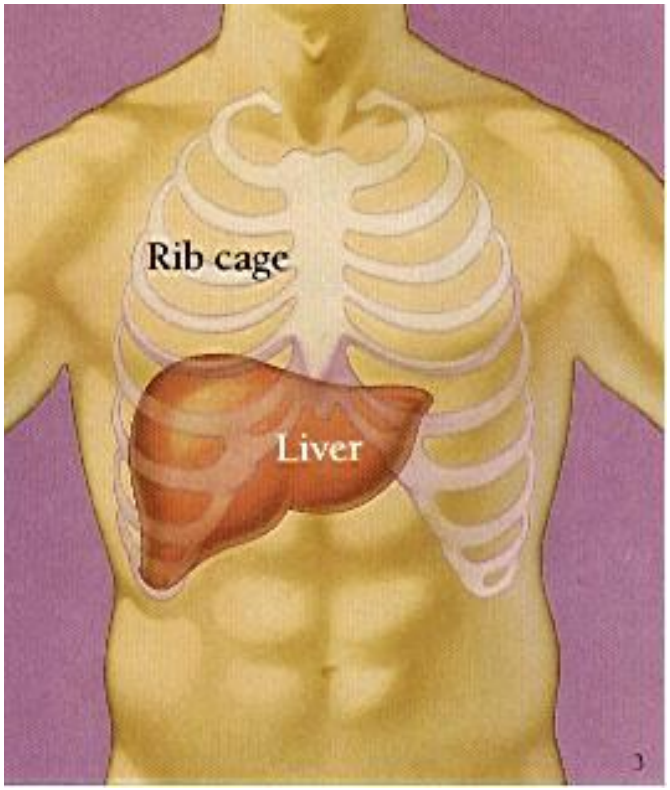
- Bone Marrow
  - Soft substance in core of bones
  - Blood cell production (Hematopoiesis):The production of all types of blood cells generated by a remarkable self-regulated system that is responsive to the demands put upon it.
    - RBCs
    - WBCs
    - Platelets



Liver

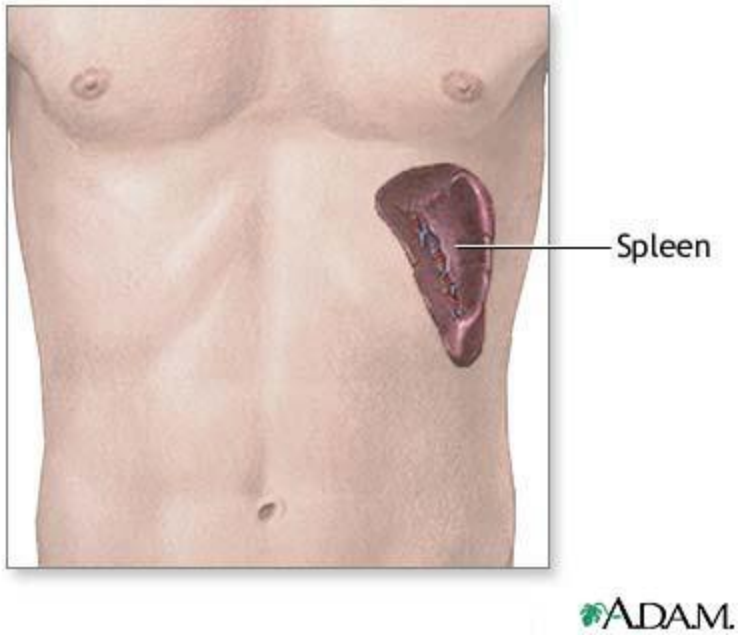
Receives 24% of the cardiac output (1500 ml of blood each minute)

- Liver has many functions
- Hematologic functions:
  - Liver synthesis plasma proteins including **clotting factors** and **albumin**
  - Liver clears damaged and non-functioning RBCs/erythrocytes from circulation



Spleen

- Located in upper L quadrant of abdomen
- Functions
  - Hematopoietic function
    - Produces fetal RBCs
  - Filter function
    - Filter and reuse certain cells
  - Immune function
    - Lymphocytes, monocytes
  - Storage function
    - 30% platelets stored in spleen



Effects of Aging on the Hematologic System

- CBC Studies
  - ↓ Hemoglobin (Hb or Hgb)
  - ↓ response to infection (WBC)
  - Platelets=no change
- Clotting Studies
  - ↓ PTT

Assessment of the Hematologic System

- Subjective Data
  - Important Health Information
    - Past health history
    - Medications
    - Surgery or other treatments

Assessment of the Hematologic System (cont.)

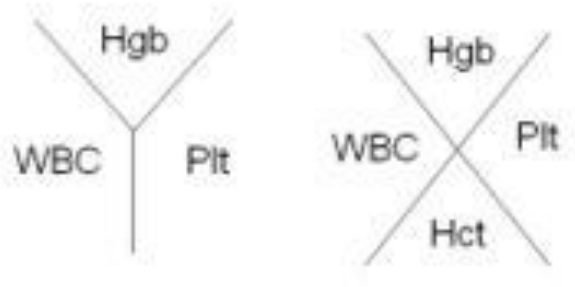
- Functional Health Patterns
  - Health perception – health management
  - Nutritional – metabolic
  - Elimination
  - Activity – exercise
  - Sleep – rest
  - Cognitive – perceptual
  - Self-perception – self-concept
  - Role – relationship
  - Sexuality – reproductive
  - Coping – stress tolerance
  - Value – belief

Assessment of the Hematologic System (cont.)

- Objective Data
  - Physical Examination
    - Skin
    - Eyes
    - Mouth
    - Lymph Nodes
    - Heart and Chest
    - Abdomen
    - Nervous System
    - Musculoskeletal System

Diagnostic Studies of the Hematologic System: Complete Blood Count (CBC)

- WBCs
  - Normal 4,000 -11,000 μ/ℓ
  - Associated with infection, inflamn death
  - *Leukopenia*-- ↓ WBC
  - *Neutropenia* -- ↓ neutrophil count



- RBC
  - ♂ 4.5 – 5.5 x $10^6/\ell$
  - ♀ 4.0 – 5.0 x $10^6/\ell$

- Hematocrit (Hct)
  - The hematocrit is the percent of whole blood that is composed of red blood cells. The hematocrit is a measure of both the number of red blood cells and the size of red blood cells.

Diagnostic Studies of the Hematologic System: Complete Blood Count (CBC) Cont'd

- Platelet count
  - Normal 150,000- 400,000
  - Thrombocytopenia-↓ platelet count
  - Spontaneous hemorrhage likely when count is below 20,000

- *Pancytopenia*
  - Decrease in number of RBCs, WBCs, and platelets

Diagnostic Studies of the Hematologic System

- Radiologic Studies
  - CT/MRI of lymph tissues
- Biopsies
  - Bone Marrow examination
  - Lymph node biopsies

TABLE 19-1 Common Laboratory Tests for Hematologic and Lymphatic Disorders

TEST	NORMAL ADULT VALUES	EXPLANATION	NURSING IMPLICATIONS
Complete Blood Count (CBC)			
Red Blood Cell (RBC) count ■ Men ■ Women	 4.6–6.0 million/μL (mm^3) 4.0–5.0 million/μL(mm^3)	Number of circulating RBCs in one microliter (cubic millimeter, or mm^3) of blood Reduced in hemorrhage, anemia, and chronic kidney disease Increased (polycythemia) in high altitude, cardiopulmonary disease	No fasting or special client preparation is necessary. Explain the test and the reason it is being done. Results may be affected by deficient or excess fluid volume.
Reticulocyte count	0.5%–1.5% of total RBC	Percentage of immature RBCs Used to help diagnose anemias and their underlying cause	No fasting or special client preparation is necessary. Explain the test and the reason it is being done.
Hemoglobin (Hgb) ■ Men ■ Women	 13.5–18 g/dL 12–15 g/dL	Amount of hemoglobin in 100 mL (1 dL) of blood Used to help diagnose anemias	No fasting or special client preparation is necessary. Do not draw a sample from an arm in which an IV is infusing. Explain why the test is being done. Results may be affected by deficient or excess fluid volume. No special preparation is required. Explain that these tests are used to help identify the underlying cause or type of anemias.
Hematocrit (Hct) ■ Men ■ Women	 40%–54% 36%–46%	Packed volume of RBCs in 100 mL of blood; reported as a percentage Used to help diagnose acute blood loss, anemias, and to monitor chronic diseases	
Mean corpuscular volume (MCV)	80–98 cuμ (fL)	Average volume of individual RBCs	
Mean corpuscular hemoglobin (MCH)	27–31 pg	Weight of the hemoglobin in an average RBC	
Mean corpuscular hemoglobin concentration (MCHC)	32%–36%	Average concentration (percent) of hemoglobin within RBC	

TABLE 19-1 Common Laboratory Tests for Hematologic and Lymphatic Disorders (continued)

TEST	NORMAL ADULT VALUES	EXPLANATION	NURSING IMPLICATIONS
WBC count	4,500–10,000/μL (mm^3)	Measures the number of WBCs in circulating blood	No food or fluid restriction is required. Inquire about manifestations of acute infection or known chronic conditions that may affect WBC count. Decreased WBCs are seen in disorders affecting blood cell production and some infections. Increased WBCs are present in acute infection, leukemias, stress responses, and some acute and chronic diseases.
Differential WBC count		Provides more specific information about infections and disease processes	
Neutrophils	50%–70% (2,500–7,000/μL)	Rapid responders to infection and tissue damage Increase in acute infection and inflammation	
Eosinophils	1%–3% (100-300/μL)	Increase during allergic and parasitic conditions	
Basophils	0.4%–1.0% (40–100/μL)	Increase during healing; decrease in stress and allergic reactions	
Lymphocytes	25%–35% (1,700–3,500/μL)	Play a major role in immune response with B lymphocytes and T lymphocytes	
Monocytes	4%–6% (200–600/μL)	Second line of defense against bacterial infection and foreign substances	
Platelets	150,000–400,000/μL (mm^3)	The number of circulating platelets in the blood Low platelet count associated with bleeding; increased count may increase risk for abnormal clotting	No client preparation is required. Observe for manifestations of bleeding. Monitor count in clients undergoing chemotherapy.
Bleeding time	3–7 minutes	Used to screen for disorders caused by platelet dysfunction	Bleeding time is prolonged by ingestion of aspirin and anti-inflammatory drugs.

Common Laboratory Tests for Hematologic and Lymphatic Disorders

Coagulation Studies			
Prothrombin time (PT or protime)	10–13 seconds (varies by laboratory)	Evaluates the extrinsic clotting pathway; prolonged in warfarin (Coumadin) therapy	No food or fluid restrictions are necessary. The INR provides a more standardized measure of Coumadin therapy.
INR (International Normalized Ratio)	2–3.0	Used to evaluate Coumadin therapy (see Chapter 18 for therapeutic values)	
Partial thromboplastin time (PTT) Activated partial thromboplastin time (APTT, PTT)	60–70 20–35 seconds	Used to evaluate clotting pathways and monitor heparin therapy More sensitive than PTT; evaluates the intrinsic clotting pathway; prolonged in heparin therapy	No food or fluid restriction is required. Values are increased in clotting factor deficiencies, heparin therapy, and aspirin ingestion.
Coombs' test	Negative	Performed to diagnose hemolytic anemias and evaluate transfusion reactions. The expected results are no detected antibodies to RBCs (indirect Coombs') or no detected RBC antigen–antibody complexes (direct Coombs').	No food or fluid restriction is required. Ask about previous transfusions or transfusion reactions. Report manifestations of transfusion reactions.
Hemoglobin electrophoresis	■ Hb A_1 95%–98% ■ Hb A_2 1.5%–4% ■ Hb F less than 2% ■ Hb C 0% ■ Hb D 0% ■ Hb S 0%	Performed to detect abnormal forms of hemoglobin associated with genetic hemolytic anemias (e.g., sickle cell anemia, thalassemia)	No food or fluid restrictions are required. Assess for and report manifestations of hemolytic anemias. Encourage the client to obtain genetic counseling.

TABLE 19-1 Common Laboratory Tests for Hematologic and Lymphatic Disorders (continued)

TEST	NORMAL ADULT VALUES	EXPLANATION	NURSING IMPLICATIONS
		Serum Iron Studies	
Iron	50–150 mcg/dL (10–27 mol/L)	Serum iron and body iron stores are measured to evaluate iron deficiency anemia.	Antibiotics, estrogen and testosterone, oral contraceptives, aspirin, and ethanol affect results.
Total iron-binding capacity	250–450 µg/dL	Measures the maximum amount of iron that can bind to transferrin, the protein that transports it	
Ferritin	Men: 15–445 ng/mL (15–445 µg/L) Women: 10–310 ng/mL (10–310 µg/L)	A measure of the amount of iron stored in body tissues	No food or fluid restrictions are required. Results in women are affected by age and use of oral contraceptives.
Transferrin	200–430 mg/dL (2.0–4.3 g/L)	Measures the protein that transports iron to the bone marrow for use in synthesizing hemoglobin	Avoid iron supplements for 12 hours before testing. Results are affected by pregnancy and use of oral contraceptives.
D-dimer	Negative	D-dimer is a fragment produced when fibrinolysis occurs. It is used primarily to diagnose disseminated intravascular coagulation.	No food or fluid restriction is required. Report manifestations such as unexplained bleeding. Monitor vital signs.

Common Laboratory Tests for Hematologic and Lymphatic Disorders

Schilling test	10%–40% of vitamin B_{12} excretion in 24 hr	Primarily used to diagnose pernicious anemia. This timed test evaluates the body's ability to absorb vitamin B_{12} from the GI tract. An oral dose of radioactively tagged vitamin B_{12} and an intramuscular vitamin B_{12} injection are administered, followed by collection of a 24-hour urine specimen.	Verify that client has given informed consent. Instruct the client to: ■ Withhold food and fluids for 8–12 hours before the test. ■ Avoid taking vitamin B supplements for 3 days before the test. May eat and drink after vitamin B_{12} injection is given. Observe for manifestations of anaphylaxis for at least 1 hour after administration of radioactive vitamin B_{12}. Collect a 24-hour urine sample (see Box 28-3 ), using rubber gloves to handle urine.

Anemia

- Anemia is a reduction in the number of RBCs, the quantity of hemoglobin, or the volume of RBCs
- Because the main function of RBCs is oxygenation, anemia results in varying degrees of hypoxia

Anemia

- Prevalent conditions
  - Blood loss
  - Decreased production of erythrocytes
  - Increased destruction of erythrocytes

Anemia (cont'd)

- **Clinical Manifestations:**

1. Pallor.
2. Fatigue, weakness.
3. Dyspnea.
4. Palpitations, tachycardia.
5. Headache, dizziness, and restlessness.
6. Slowing of thought.
7. Paresthesia.

Anemia (cont'd)

Nursing Management:

1. Direct general management toward addressing the cause of anemia and replacing blood loss as needed to sustain adequate oxygenation.
2. Promote optimal activity and protect from injury.
3. Reduce activities and stimuli that cause tachycardia and increase cardiac output.
4. Provide nutritional needs.
5. Administer any prescribed nutritional supplements.
6. Patient and family education

Nursing Actions for a Patient who is Anemic or Suffered Blood Loss

- Administer oxygen as prescribed
- Administer blood products as prescribed
- Administer erythropoietin as prescribed
- Allow for rest between periods of activity
- Elevate the pt's head on pillows during episodes of shortness of breath
- Provide extra blankets if the pt feels cool
- Teach the pt/family about underlying pathophysiology and how to manage the symptoms of anemia

Anemia Caused by Decreased Erythrocyte Production

- Iron Deficiency Anemia
- Thalassemia
- Megablastic Anemia

Iron-Deficiency Anemia

Etiology

1. Inadequate dietary intake
   - Found in 30% of the world's population
2. Malabsorption
   - Absorbed in duodenum
   - GI surgery
3. Blood loss
   - 2 mls blood contain 1mg iron
   - GI, GU losses
4. Hemolysis

Iron-Deficiency Anemia

- Clinical Manifestations
  - Most common: pallor
  - Second most common: inflammation of the tongue (glossistis)
  - Cheilitis=inflammation/fissures of lips
  - Sensitivity to cold
  - Weakness and fatigue
- Diagnostic Studies
  - CBC
  - Iron studies Diagnostics:
  - Iron levels: Total iron-binding capacity (TIBC), Serum Ferritin.
  - Endoscopy/Colonscopy

Iron-Deficiency Anemia

- Collaborative Care
  - Treatment of underlying disease/problem
  - Replacing iron
  - Diet
  - Drug Therapy
    - Iron replacement
      - Oral iron
        - Feosol, DexFerrum, etc
        - Absorbed best in acidic environemtn
        - GI effects
      - Parenteral iron
        - IM or IV
        - Less desirable than PO

Iron-Deficiency Anemia
Nursing Management

- Assess cardiovascular & respiratory status
- Monitor vital signs
- Recognizing s/s bleeding
  - Monitor stool, urine and emesis for occult blood
- Diet teaching—foods rich in iron
- Provide periods of rest
- Supplemental iron
- Discuss diagnostic studies
- Emphasize compliance
- Iron therapy for 2-3 months after the hemoglobin levels return to normal

Thalassemia

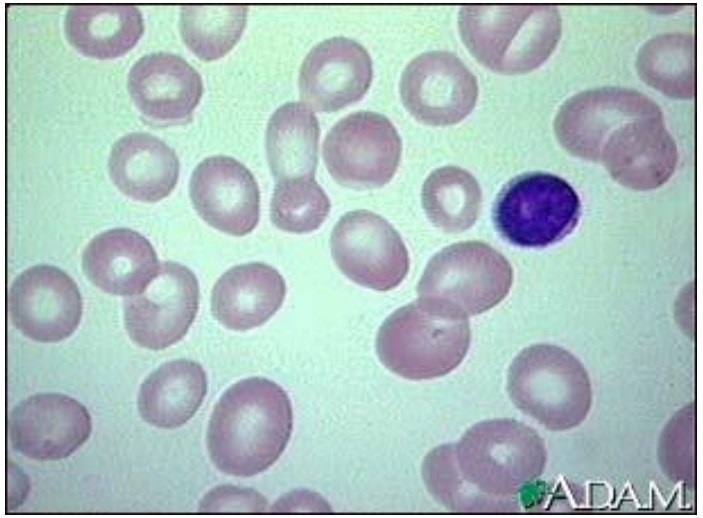
- Etiology
  - Autosomal recessive genetic disorder of inadequate production of normal hemoglobin
  - Found in Mediterranean ethnic groups
- Clinical Manifestations
  - Asymptomatic → major retardation → life threatening
  - Splenomegaly, hepatomegaly

Thalassemia
Collaborative Care

- No specific drug or diet are effective in treating thalassemia
- Thalassemia minor
  - Body adapts to ↓ Hgb
- Thalassemia major
  - Blood transfusions with IV deferoxamine (used to remove excess iron from the body)

Megaloblastic Anemias

- Characterized by large RBCs which are fragile and easily destroyed
- Common forms of megaloblastic anemia
  1. Cobalamin deficiency
  2. Folic acid deficiency



This picture shows large, dense, oversized, red blood cells (RBCs) that are seen in megaloblastic anemia.

Cobalamin (Vitamin B_{12}) Deficiency

- Cobalamin Deficiency--formerly known as pernicious anemia
- ***Vitamin B_{12}*** *(cobalamin) is an important water-soluble vitamin.*
- *Intrinsic factor* (IF) is required for cobalamin absorption
- Causes of cobalamin deficiency
  - Gastric mucosa not secreting IF
  - GI surgery →loss of IF-secreting gastric mucosal cells
  - Long-term use of H_2-histamine receptor blockers cause atrophy or loss of gastric mucosa.
  - Nutritional deficiency
  - Hereditary defects of cobalamine utilization

Cobalamin (Vitamin B_{12}) Deficiency

- Clinical manifestations
  - General symptoms of anemia
  - Sore tongue
  - Anorexia
  - Weakness
  - Parathesias of the feet and hands
  - Altered thought processes
    - Confusion → dementia

Cobalamin Deficiency
Diagnostic Studies

- RBCs appear large
- Abnormal shapes
- Structure contributes to erythrocyte destruction
- Schilling Test: a medical investigation used for patients with vitamin B12 deficiency. The purpose of the test is to determine if the patient has pernicious anemia.

Cobalamin Deficiency

- Collaborative Care
  - Parenteral administration of cobalamin
  - ↑ Dietary cobalamin does not correct the anemia
    - Still important to emphasize adequate dietary intake
  - Intranasal form of cyanocobalamin (Nascobal) is available
  - High dose oral cobalamin and SL cobalamin can use be used

Cobalamin Deficiency

- Nursing Management
  - Familial disposition
    - Early detection and treatment can lead to reversal of symptoms
  - Potential for Injury r/t patient's diminished sensations to heat and pain
  - Compliance with medication regime
  - Ongoing evaluation of GI and neuro status
    - Evaluate patient for gastric carcinoma frequently

Folic Acid Deficiency

- Folic Acid Deficiency also causes megablastic anemia (RBCs that are large and fewer in number)
- Folic Acid required for RBC formation and maturation
- Causes
  - Poor dietary intake
  - Malabsorption syndromes
  - Drugs that inhibit absorption
  - Alcohol abuse
  - Hemodialysis

Folic Acid Deficiency

- Clinical manifestations are similar to those of cobalamin deficiency
- Insidious onset: progress slowly
- Absence of neurologic problems
- Treated by folate replacement therapy
- Encourage patient to eat foods with large amounts of folic acid
  - Leafy green vegetables
  - Liver
  - Mushrooms
  - Oatmeal (الشوفان المجروش)
  - Peanut butter
  - Red beans

Anemia of Chronic Disease

- Underproduction of RBCs, shortening of RBC survival
- 2nd most common cause of anemia (after iron deficiency anemia
- Generally develops after 1-2 months of sustained disease
- Causes
  - Impaired renal function
  - Chronic, inflammatory, infectious or malignant disease
  - Chronic liver disease
  - Folic acid deficiencies
  - Splenomegaly
  - Hepatitis

Aplastic Anemia

- Characterized by Pancytopenia
  - ↓ of all blood cell types
    - RBCs
    - White blood cells (WBCs)
    - Platelets
  - Hypocellular bone marrow
- Etiology
  - Congenital
    - Chromosomal alterations
  - Acquired
    - Results from exposure to ionizing radiation, chemical agents, viral and bacterial infections

Aplastic Anemia

- Etiology
  - Low incidence
    - Affecting 4 of every 1 million persons
  - Manageable with erythropoietin or blood transfusion
  - Can be a critical condition
    - Hemorrhage
    - Sepsis

Aplastic Anemia

- Clinical Manifestations
  - Gradual development
  - Symptoms caused by suppression of any or all bone marrow elements
  - General manifestations of anemia
    - Fatigue
    - Dyspnea
    - Pale skin
    - Frequent or prolonged infections
    - Unexplained or easy bruising
    - Nosebleed and bleeding gums
    - Prolonged bleeding from cuts
    - Dizziness
    - headache

Aplastic Anemia

- Diagnosis
  - Blood tests
    - CBC
  - Bone marrow biopsy

Aplastic Anemia

- Treatment
  - Identifying cause
  - Blood transfusions
  - Antibiotics
  - Immunosuppressants (neoral, sandimmune)
    - Corticosteroids (Medrol, solu-medrol)
  - Bone marrow stimulants
    - Filgrastim (Neupogen)
    - Epoetin alfa (Epogen, Procrit)
  - Bone marrow transplantation

Aplastic Anemia

- Nursing Management
  - Preventing complications from infection and hemorrhage
  - Prognosis is poor if untreated
    - 75% fatal

Anemia Caused By Blood Loss

- Acute Blood Loss
- Chronic Blood Loss

Acute Blood Loss

- Result of sudden hemorrhage
  - Trauma, surgery, vascular disruption
- Collaborative Care
  1. Replacing blood volume
  2. Identifying source of hemorrhage
  3. Stopping blood loss

Chronic Blood Loss

- Sources/Symptoms
  - Similar to iron deficiency anemia
  - GI bleeding, hemorrhoids, menstrual blood loss
- Diagnostic Studies
  - Identifying source
  - Stopping bleeding
- Collaborative Care
  - Supplemental iron administration

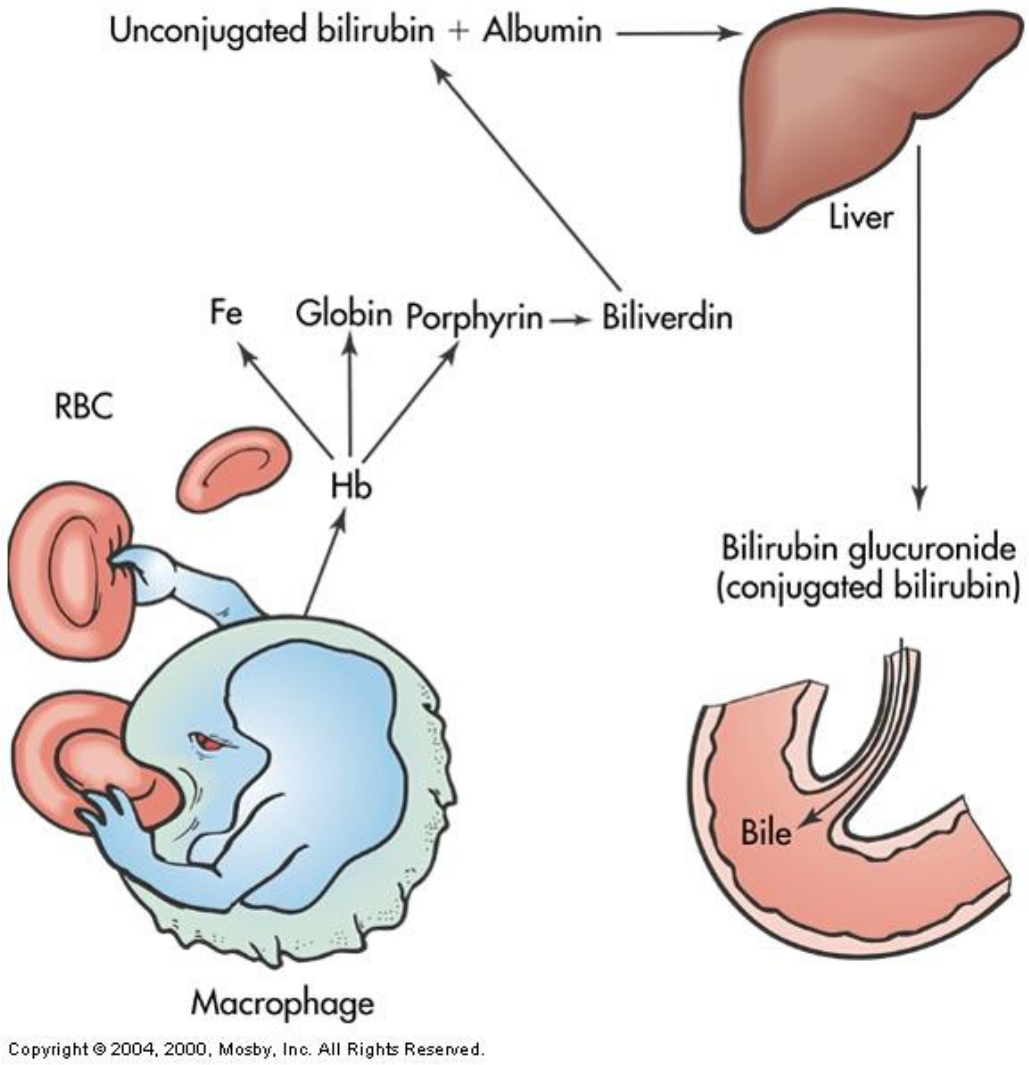
Anemia caused by Increased Erythrocyte Destruction

- Hemolytic Anemia
  - Sickle Cell disease (peds)
  - Acquired Hemolytic Anemia
  - Hemochromatosis
  - Polycythemia

Hemolytic Anemia

- Destruction or hemolysis of RBCs at a rate that exceeds production
- Third major cause of anemia
- Intrinsic hemolytic anemia
  - Abnormal hemoglobin
  - Enzyme deficiencies
  - RBC membrane abnormalities
- Extrinsic hemolytic anemia
  - Normal RBCs
  - Damaged by external factors
    - Liver
    - Spleen
    - Toxins
    - Mechanical injury (heart valves)

Sequence of Events in Hemolysis



Acquired Hemolytic Anemia

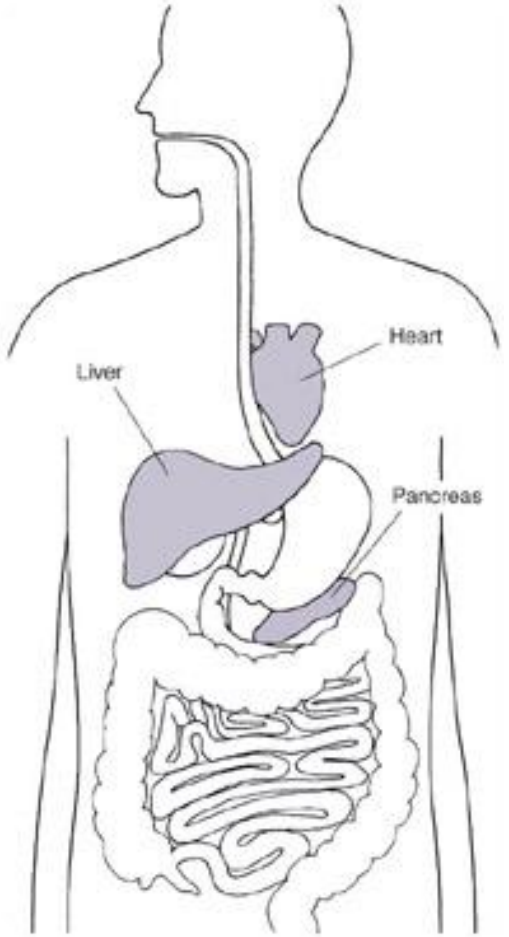
- Causes
  - Medications
  - Infections
- Manifestations
  - S/S of anemia
- Complications
  - Accumulation of hemoglobin molecules can obstruct renal tubules $\rightarrow$ Tubular necrosis
- Treatment
  - Eliminating the causative agent

Potential Nursing Dx for Patients with Anemia

- **Activity Intolerance** r/t weakness, malaise m/b difficulty tolerating ↑'d activity
- **Imbalance nutrition: less than body requirements** r/t poor intake, anorexia, etc. m/b wt loss, ↓ serum albumin, ↓ iron levels, vitamin deficiencies, below ideal body wt.
- **Ineffective therapeutic regimen management** r/t lack of knowledge about nutrition/medications etc. m/b ineffective lifestyle/diet/medication adjustments
- Collaborative Problem: **Hypoxemia** r/t ↓hemoglobin

Hemochromatosis

- Iron overload disease
- Over absorption and storage of iron causing damage especially to liver, heart and pancreas



Polycythemia

- **Polycythemia** is a condition in which there is a net increase in the total number of red blood cells
- Overproduction of red blood cells may be due to
  - a primary process in the bone marrow (a so-called myeloproliferative syndrome)
  - or it may be a reaction to chronically low oxygen levels or
  - malignancy

Polycythemia

- Complications
  - ↑d viscosity of blood
  - → hemorrhage and thrombosis
- Treatment
  - Phlebotomy
  - Myelosupressive agents: A number of new therapeutic agents such as, interferon alfa-2b (Intron A) therapy, agents that target platelet number (e.g., anagrelide [Agrylin]), and platelet function (e.g., aspirin).

Thrombocytopenia

- Disorder of decreased platelets
- platelet count below 150,000
- Causes
  - Low production of platelets
  - Increased breakdown of platelets
- Symptoms
  - Bruising
  - Nosebleeds
  - Petechiae (pinpoint microhemorrhages)

Thrombocytopenia

- Types of Thrombocytopenia
  - Immune Thrombocytopenic Purpura
    - Abnormal destruction of circulating platelets
    - Autoimmune disorder
    - Destroyed in hosts' spleen by macrophages
  - Thrombotic Thrombocytopenic Purpura
    - ↑d agglutination of platelets that from microthrombi

Heparin-Induced Thrombocytopenia (HIT)

- HIT
  - Associated with administration of heparin
  - Develops when the body develops an antibody, or allergy to heparin
  - Heparin (paradoxically) causes thrombosis
  - Immune mediated response that casues intense platelet activation and relaese of procoaggulation particles.
- Clinical features
  - Thrombocytopenia
  - Possible thrombosis after heparin therapy
    - Can be triggered by any type, route or amount of heparin

Thrombocytopenia

Diagnostic Studies

- Platelet count
- Prothrombin Time (PT)
- Activated Partial Thromboplastin Time (aPTT)
- Hgb/Hct

- Treatment
  - Based on cause
  - Corticosteroids
  - Plasmaphoresis
  - Splenectomy
  - Platelet transfusion