Hematologic System

**PHYSIOLOGY OF THE BLOOD**

A. Components.
   1. Plasma: 90% water; accounts for about half of the total blood volume.
   2. Formed elements (cells): account for about half of the volume.
      a. Erythrocytes (red blood cells [RBCs]).
      b. Leukocytes (white blood cells).
      c. Thrombocytes (platelets).

B. Characteristics of plasma (Figure 14-1).
   1. Plasma is clear, straw-colored; it does not contain cellular elements.
   2. Liquid portion of the circulating volume consists of 91% to 92% water.
   3. Protein: 6% to 8% of the plasma.
      a. Albumin: most abundant protein; maintains normal colloid osmotic pressure of the plasma.
      b. Globulins.
         (1) Gamma globulins (immunoglobulins) consist primarily of antibodies produced by the plasma cells.
         (2) Alpha and beta globulins are essential factors in the clotting mechanism.
      c. Fibrinogen: necessary element in normal clot formation; produced in the liver.
      d. Prothrombin: necessary element for normal coagulation.
         (1) Produced in the liver.
         (2) Normal production is dependent on availability of adequate vitamin K.
      e. Normal body nutrients are carried by the plasma.
         (1) Carbohydrates in the form of glucose.
         (2) Proteins in the form of amino acids.
         (3) Fat in the form of lipids.
      f. Metabolic waste products are carried to organs of excretion by the plasma.
         (1) Urea, uric acid.
         (2) Lactic acid, creatinine.

C. Characteristics of erythrocytes (RBCs).
   1. Formed in the red bone marrow (reticuloendothelial system); erythropoiesis is production of RBCs.
   2. In early childhood, all bones contain red marrow; as child grows older, red marrow is replaced with fatty, yellow marrow.
   3. In the adult, only specific bones contain red marrow (humerus, proximal end of the femur, iliac crest).
   4. In conditions causing low oxygen tension, the kidneys initiate formation of erythropoietin, which then stimulates erythrocyte production.
   5. Vitamin \( \text{B}_12 \) and folic acid are necessary for the production of normal erythrocytes.
   6. Erythrocytes: primary function is transportation of oxygen and carbon dioxide.
      a. Hemoglobin is the primary component of the RBC.
         (1) Serves as a buffer in the acid-base balance.
         (2) Hemoglobin combines easily with oxygen to form oxyhemoglobin.
         (3) Iron is a major component of hemoglobin and is necessary for normal oxygen transport.
         (4) Reduced hemoglobin has given up its oxygen component.
      b. Hematocrit is a fraction of the blood occupied by the erythrocytes.

7. When RBCs are exposed to hypotonic solutions, water enters the cells, thus precipitating cellular wall rupture and destruction or hemolysis of the RBCs.
8. Hemolysis also occurs when cellular membranes are damaged, as in trauma.
9. The life span of an erythrocyte is approximately 120 days or 4 months.
10. Old erythrocytes are removed from circulation by the liver, spleen, and bone marrow; iron is salvaged and returned to the bone marrow; the remainder of each cell is converted to bile pigments, which are excreted by the liver.

D. Characteristics of the leukocytes (white blood cells).
   1. Primary work of the leukocytes is accomplished when the cells leave the circulating volume and enter the body tissue.
CHAPTER 14  Hematologic System

FIGURE 14-1 Approximate values for the components of blood in the adult. Normally, 45% of the blood is composed of blood cells, and 55% is composed of plasma. (From Thibodeau GA, Patton KT: Anatomy and physiology, ed 6, St. Louis, 2007, Mosby.)

2. Types of cells.
   a. Granulocytes (polymorphonuclear leukocytes) originate in the bone marrow.
      (1) Consist of neutrophils, eosinophils, and basophils.
      (2) Primary function is to destroy bacteria (phagocytosis).
   b. Agranular leukocytes (mononuclear) originate primarily in the lymphatic tissue.
      (1) Consist of lymphocytes and monocytes.
      (2) Assist in the removal of broken-down tissue cells.
      (3) Release substances that enhance the activity of the granulocytes.

3. Life span of the leukocyte is variable.

4. Leukocytosis refers to an overall increase in leukocytes; leukopenia refers to an overall decrease in leukocytes.

E. Characteristics of thrombocytes (platelets).
1. Smallest of the formed cells in the circulating volume.
2. Function: primarily involved with hemostasis; when vessel wall is damaged, platelets adhere to the area and eventually form a platelet plug to decrease bleeding.
3. Thrombocytosis refers to a marked abnormal increase in thrombocytes; thrombocytopenia refers to a marked abnormal decrease in thrombocytes.

F. Hemostasis.
1. Extrinsic mechanisms: clotting process initiated by tissue damage and blood loss.
   2. Intrinsic mechanism: clotting process initiated within the vessel where blood loss and tissue trauma are not present.
   3. Both mechanisms produce the same result: clot formation.

4. Three phases of hemostasis (coagulation).
   a. First phase: tissue injury precipitates release of platelet factor; in presence of calcium and accessory factors, thromboplastin is formed.
   b. Second phase: prothrombin is converted to thrombin; thromboplastin in phase 1 initiates the conversion of prothrombin.
   c. Third phase: thrombin converts soluble fibrinogen to insoluble fibrin (fibrin is an insoluble protein that looks like a fine network of thread or a web).

5. Erythrocytes are not part of the actual coagulation process; RBCs are essentially trapped in the fibrin mesh and give the clot its characteristic color.

6. Fibrinolysis: process by which clots, formed in tissue and small vessels, are dissolved by fibrinolysin.

G. Blood classification.
1. Major blood groups: A, B, AB, and O.
   a. Blood compatibility and systems of classification are based on the presence or absence of specific antigens present on RBCs, as well as specific antibodies in the plasma.
   b. There are two antigens, or agglutinable substances, present on RBCs: A and B.
      (1) Neither antigen is present in O.
      (2) A is present in A.
      (3) B is present in B.
      (4) A and B are present in AB.
   c. There are two antibodies present in the plasma:
      anti-A and anti-B.
      (1) Both antibodies are present in O.
      (2) Anti-B is present in A.
      (3) Anti-A is present in B.
      (4) Neither is present in AB.
   d. If the antigen A on the RBCs of the donors comes in contact with the antibody A of the recipient and vice versa, agglutination and clumping will occur (e.g., type A blood transfused into type B recipient).
   e. O negative is called the universal donor because there are no antigens on the RBCs, and the Rh factor is not present.
   f. AB positive is called the universal recipient because there are no antibodies in the serum, and the Rh factor is present.
   g. In agglutination and clumping of RBCs, hemolysis occurs; hemolysis releases hemoglobin into the plasma.
   h. Problems occur with the destruction of the donor’s RBCs by the plasma of the recipient’s cells.

2. Rh factor.
   a. Rh factor is present on the RBC.
   b. Rh is positive, or factor is present, in 85% to 95% of the population.
c. Rh is negative, or factor is absent, in 5% to 15% of the population.
d. Normal plasma does not contain Rh antibodies. Antibodies are formed in Rh-negative blood if transfused with Rh-positive blood; thus the recipient is sensitized to the Rh factor and subsequent Rh-positive blood might result in a severe transfusion reaction.
e. Problems of sensitization occur in the newborn when the mother is Rh negative and the infant is Rh positive (see Chapter 26).

**System Assessment**

A. History.
   1. Disease of bone marrow and/or RBC-producing organs.
   2. Treatment that depressed bone marrow activity (especially chemotherapy or radiation therapy).
   3. Family history of problems (inheritance pattern).
B. Bleeding problems occurring during pregnancy, labor and delivery, or immediately after delivery in both mother and infant.
C. Presence of chronic disorders or disease processes (liver, kidney, or spleen disorders).
D. Effects of aging (Table 14-1).
E. Evaluate effect hematologic disorder has on client’s activities of daily living.
   1. How long has client experienced symptoms?
   2. What are the client’s current activities and metabolic requirements?
   3. Presence or absence of bleeding episodes.
   4. Presence or absence of pain. If pain is present, how well is it controlled?
   5. Presence of appropriate coping/defense mechanisms.
F. Assess client’s current nutritional status.
G. Evaluate current blood values.
H. Evaluate status of respiratory and cardiovascular systems in maintaining homeostasis.

**Table 14-1 AGE-RELATED ASSESSMENT FINDINGS FOR THE HEMATOLOGIC SYSTEM**

<table>
<thead>
<tr>
<th>Assessment Area</th>
<th>Hematologic System Findings</th>
<th>Older Adult Changes and Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nail beds (check for capillary refill)</td>
<td>Pallor, cyanosis, and decreased capillary refill are often noted in hematologic disorders.</td>
<td>Nails are typically thickened and discolored. Need to use another body area, such as the lips, to assess capillary refill. Older adults are losing body hair, but often in an even pattern distribution that has occurred slowly over time. Lack of hair only on lower legs and toes may indicate poor circulation. Dry skin is a normal aspect of aging and thus becomes an unreliable indicator of skin moisture. Pigment loss and skin changes along with some yellowing occur with aging. Pallor that is not associated with anemia may be noted in older adults, because they tend not to go outdoors and get exposed to sunlight.</td>
</tr>
<tr>
<td>Hair distribution</td>
<td>Thin or absent hair on trunk and extremities may indicate poor oxygenation and blood supply to area.</td>
<td></td>
</tr>
<tr>
<td>Skin moisture and color</td>
<td>Skin dryness, pallor, and jaundice may occur with anemia, leukemia, etc.</td>
<td></td>
</tr>
</tbody>
</table>
E. Iron deficiency anemia: characterized by inadequate intake of dietary iron or excessive loss of iron.
1. Risk factors/etiology.
   b. Occurs in infants whose primary diet is milk.
   c. May occur in pregnancy.
   d. Heavy flow during menses.
2. Older adults are more prone to iron deficiency anemia because of poor dietary iron intake and decreased absorption in the small intestine.
3. Diagnostics: decreased hemoglobin and hematocrit values.
   a. May be asymptomatic in the early stages.
   b. General symptoms of anemia.
   c. Pallor, glossitis, cheilitis—three most common findings.
5. Treatment: supplemental iron intake is necessary for 6 months to replenish body storage.
   a. Suplemental iron (see Appendix 14-2).
   b. Increased dietary iron intake (see Table 2-2).
   c. Supplemental folic acid.

F. Pernicious anemia: condition characterized by an inability to absorb vitamin B₁₂ (cobalamin). It may be associated with loss of intrinsic factor (gastric resection), or it may be an autoimmune problem.
1. Risk factors/etiology.
   a. Generally not associated with inadequate dietary intake.
   b. More common in older adult; most common age at diagnosis is 60 years.
   c. Familial tendency.
   d. May be precipitated by gastric resection, gastritis, or chronic alcoholism.
2. Diagnostics (see Appendix 14-1).
   a. Homocysteine, cobalamin, and serum folate levels.
   b. Reduced number of RBCs and presence of abnormal RBCs.
   c. Gastric analysis for free hydrochloric acid.
3. Clinical manifestations.
   a. General symptoms of anemia, confusion.
   b. Paresthesia in the extremities, weakness, reduced vibratory sense.
   c. Loss of sense of balance, ataxia.
   d. Smooth, beefy, red tongue (glossitis).
4. Treatment.
   a. Injections of vitamin B₁₂ may be required indefinitely.
   b. Maintain good nutrition with adequate iron, vitamin C, and folic acid intake.
   c. Monitor for gastric cancer—there is increased potential with pernicious anemia.

G. Aplastic anemia: characterized by depression of the bone marrow in production of all blood cell types—RBCs, WBCs, and platelets.
1. Risk factors/etiology.
   a. Examples of medications and chemicals that can precipitate aplastic anemia.
      (1) Chemotherapeutic agents, radiation.
      (2) Benzene, insecticides, arsenic.
      (3) Chloramphenicol.
      (4) Anticonvulsant medications (e.g., Dilantin).
   b. Radiation therapy.
   c. Up to 70% of cases are idiopathic in origin.
2. Diagnostics: bone marrow biopsy reveals severe decrease in all marrow elements (pancytopenia; see Appendix 14-1).
3. Clinical manifestations.
   a. General symptoms of anemia.
   b. Fever.
   c. Infections associated with neutropenia.
   d. Bleeding problems associated with thrombocytopenia.
4. Treatment.
   a. Remove causative agent.
   b. Hematopoietic stem cell transplant (see Appendix 14-4).
   c. Immunosuppression with antithymocytic globulin (ATG) and cyclosporine.

H. Folic acid deficiency anemia: associated with decreased dietary intake of folic acid.
1. Risk factors/etiology (origin very similar to that of vitamin B₁₂ deficiency).
   a. Poor nutrition due to decreased folic acid intake, alcoholism, anorexia.
   b. Malabsorption syndromes.
   c. Deficiency may occur with increased demands for folic acid: infancy, adolescence, and pregnancy.
   d. Drugs: anticonvulsants and oral contraception.
   e. Hemodialysis.
2. Clinical manifestations.
   a. Slow, insidious onset.
   b. Weight loss, emaciated.
   c. May appear ill with malnourishment.
3. Diagnostics.
   a. Differentiate between folic acid deficiency and vitamin B₁₂ deficiency.
   b. Serum folate levels less than 2 ng/mL.
4. Treatment: folic acid injections may be necessary initially; then oral replacement may be appropriate, 1 mg/day.

Nursing Interventions
For all clients with anemia.

**Goal:** To assist in establishing a diagnosis.
A. Complete nutritional evaluation.
B. History of possible causes.

**Goal:** To decrease body oxygen needs.
A. Assess client's tolerance to activity.
B. Provide diversional activities but also provide for adequate rest.
C. May need supplemental oxygen.

**Goal:** To prevent infections.
A. Decrease exposure.
B. Evaluate for temperature elevations frequently.
C. Observe for leukocytosis.
D. Maintain adequate hydration.

**Goal:** To assess for complications of chronic anemic state.
A. Evaluate ability of cardiovascular system to maintain adequate cardiac output.
B. Evaluate for symptoms of hypoxia (see Chapter 15).

**Goal:** To help client understand implications of disease and measures to maintain health.
A. Explain medical regimen.
B. Discuss importance of continuing medical follow-up.
C. Explain side effects of medications.
D. Identify foods high in iron and folic acid (see Chapter 2).

**Sickle Cell Anemia**
Sickle cell anemia is a problem characterized by the sickling effect of the erythrocytes, an inherited autosomal recessive disorder.

**A.** Basic defect of the erythrocyte is in the globulin portion of the hemoglobin.

**B.** Sickling problem is not apparent until around 6 months of age; the increased levels of fetal hemoglobin up to that age prevent serious sickling problems.

**C.** Predominantly a problem of children and adolescents. A child may be asymptomatic between crises. The problems from childhood may cause long-term complications as they become adults.

**D.** Pathologic changes of sickle cell disease result from:
1. Increased blood viscosity.
2. Increased RBC destruction.
3. Increased viscosity eventually precipitates ischemia and tissue necrosis caused by capillary stasis and thrombosis.
4. Cycle of occlusion, ischemia, and infarction to vascular organs.

**E.** Conditions precipitating sickling effect.
1. Dehydration.
2. Acidosis.
3. Hypoxia.
4. Infection with temperature elevation.
5. Pathologic effects of sickle cell disease on pregnancy.

1. **Mother.**
   a. Increased anemia problems.
   b. Increase in thromboembolic problems.
   c. Increased risk for preeclampsia.

2. **Infant.**
   a. Small for gestational age (SGA).
   b. Spontaneous abortion.
   c. Fetal distress caused by hypoxia.

**G.** Multiple body systems are involved.

**Assessment**
A. Risk factors/etiology.
1. Autosomal recessive disorder (see Chapter 24).
   a. Normal hemoglobin (HgbA) is replaced by abnormal sickle hemoglobin (HgbS).
   b. Presence of HgbS in 35% to 45% of hemoglobin indicates sickle cell trait.

2. May also occur in persons of Mediterranean, Caribbean, Arabian, East Indian, and Hispanic descent.

B. Clinical manifestations: primarily the result of obstruction caused by sickled RBCs and by increased RBC destruction.
1. Splenomegaly: caused by congestion and engorgement with sickled cells; decreases immune response.
2. Liver failure, hepatomegaly, and necrosis from severe impairment of hepatic blood flow.
3. Kidney damage caused by the congestion of glomerular capillaries and tubular arterioles.
4. Skeletal changes caused by hyperplasia and congestion of bone marrow.

C. Crisis: often precipitated by an infection or dehydration; can occur spontaneously (Figure 14-2).
1. Vaso-occlusive crisis: blood flow is impaired by sickled cells, causing ischemia and pain.
   a. Extremities: occlusions in the small distal bones of the hands and the feet, characterized by pain, swelling, and decreased function (hand-foot syndrome).
   c. Pulmonary: symptoms of pneumonia.
   d. Renal: hematuria.
   e. CNS: visual problems.


**ALERT** Recognize occurrence of a hemorrhage. Bleeding in a client with sickle cell anemia produces different symptoms than bleeding in a client who has undergone surgery; plan and implement nursing care to prevent complications; notify health care provider regarding signs of potential complications.

D. Diagnostics (see Appendix 14–1): early diagnosis, before 3 months of age, helps to minimize complications.
1. Hemoglobin electrophoresis indicates the presence and percentage of Hgb S.
2. Sickle turbidity tests (SICKLEDEX) used for screening.
**Sickle Cell Anemia Crisis**

- Cell Clumping
- Obstruction produces vasocclusive crisis
- Pain
- Abdominal & Long Bones
- Hand Syndrome
  - Joint Pain

- Complications
- Infections
- Stroke
- URIs
- Leg Ulcers
- Spleenomegaly

* Treatment *
- (Hospital-Child To It) Hydration
- Oxygenation
- Pain Relief

**FIGURE 14-2** Sickle cell anemia crisis. (From Zerwekh J, Claborn J: *Memory notebook of nursing*, vol 2, ed 3, Ingram, Texas, 2007, Nursing Education Consultants.)

**Treatment**

A. Prevention of the sickling problem.
   1. Adequate hydration.
   2. Prevent infections, especially respiratory tract infections; pneumococcal vaccine is recommended.
   3. Clients generally do not require iron because of increased resorption.
   4. Daily folic acid supplement.
   5. Hydroxyurea (Droxia, Hydrea) to increase the production of Hgb F thereby reducing hemolysis and the number of sickled cells.
   6. Oxygen: assists to prevent a crisis in clients with respiratory problems, but it does not reverse a sickling crisis or reduce pain.

B. Treatment of crisis.
   1. Bed rest, hydration, antibiotics.
   2. Analgesics for pain; promote adequate oxygenation.
   3. Blood transfusions and/or exchange transfusions (see Appendix 14-3).

C. Surgery: splenectomy for severe splenic sequestration.

**Nursing Interventions**

**Goal:** To prevent sickle cell disease.

A. Participate in community screening programs and education.

B. Refer persons who are carriers (autosomal recessive trait) for genetic counseling (see Figure 24-1).

**Goal:** To prevent sickling crisis.

A. Maintain adequate hydration; intravenous (IV) fluids may be necessary.

B. Promote respiratory health and tissue oxygenation.

C. Prevent infection.

D. Hydroxyurea (Droxia, Hydrea): reduces sickling episodes, a long-term complication of leukemia.

**Goal:** To control pain.

A. Assessment of involved area.

B. Appropriate analgesics: meperidine (Demerol) is not recommended; morphine, hydromorphone, fentanyl or methadone may be used; patient-controlled analgesia (PCA) devices are frequently used to control pain.

C. Allow client to assume a position of comfort; passive range of motion may be beneficial.

D. Maintain rest if movement exacerbates pain.

**ALERT** Determine effectiveness of pain control. Care of the child with sickle cell disease frequently centers around pain control (see Chapter 3).

**Goal:** To maintain adequate hydration and oxygenation.

A. Evaluate adequacy of hydration.

B. Low specific gravity may not be indicative of fluid balance if there is renal involvement.

C. Monitor IV fluid administration carefully; maintain accurate intake and output records.

D. Evaluate electrolyte balance.

E. Administer oxygen as indicated.

F. Provide good pulmonary hygiene.

G. Assess for metabolic acidosis.

**ALERT** Monitor hydration status; evaluate client’s response to parenteral administration of fluids.

**Goal:** To identify complication of affected organs—systematic evaluation of client to identify problems discussed in section on clinical manifestations.

**Home Care**

A. Increase fluids with physical activity, living in excessively hot/cold climates.

B. Seek early intervention for symptoms of infection, especially respiratory tract infection; report temperature elevations, coughing, or pain.

C. Encourage normal growth and developmental activities as tolerated by the child.

D. Client with sickle cell disease should avoid situations that may precipitate hypoxia.
   1. Traveling to high-altitude areas.
   2. Flying in an unpressurized aircraft.
   3. Participating in overly strenuous exercise.

E. Inform all significant health care personnel that child should wear medical identification.

**ALERT** Compare physical development of client with normal development. Chronically ill children frequently are slower in growth and development; care is provided for the developmental level, not the chronologic age.

**Polycythemia Vera (Primary)**

Polycythemia vera is a chronic disorder characterized by a proliferation of all red marrow cells due to a chromosomal mutation.
**Assessment**

A. Risk factors: usually occurs during middle age; median age is 60 years.
B. Diagnostics.
   1. Increased erythrocytes, hematocrit.
   2. Increased leukocytes in the bone marrow.
   3. Excessive production of platelets.
   4. Bone marrow biopsy demonstrates hypercellularity.
C. Clinical manifestations.
   1. Early: headache, vertigo, tinnitus, pruritus.
   2. Ruddy complexion (plethora).
   3. Hepatosplenomegaly; peptic ulcer, dyspepsia.
   4. Problems of decreased blood flow.
      a. Angina, hypoxia.
      b. Claudication (pain in muscles during activity).
      c. Thrombophlebitis.
      d. Hypertension: increased blood viscosity or peripheral resistance.
   5. Complication: stroke secondary to thrombosis.

**Treatment**

A. Phlebotomy (2 to 3 times per week initially, then every 2 to 3 months).
B. Myelosuppressive agents (Myleran, Hydrea).
C. Symptom management: paroxetine (Paxil) for erythrocyte (immature) cells.

**Nursing Interventions**

**Goal:** To help client understand dietary implications to deal with inadequate food intake due to peptic ulcer pain, dyspepsia, and symptoms of hyperuricemia (gout).

**Goal:** To help client understand implications of the disease and long-term health care needs (i.e., prevention of DVT).

**Leukemia**

Leukemia is an uncontrolled proliferation of abnormal white blood cells; eventual cellular destruction occurs as a result of the infiltration of the leukemic cells into the body tissue.

A. Highly vascular organs of the reticuloendothelial system are primarily affected; spleen, liver, and lymph nodes show marked infiltration, enlargement, and eventually fibrosis.
B. Invasion of the bone marrow by the leukemic cells can precipitate pathologic fractures.
C. Three primary consequences of leukemia.
   1. Anemia from RBC destruction and bleeding.
   2. Infection associated with neutropenia.
   3. Bleeding tendencies caused by decreased platelets.
D. Types of leukemia.
   1. Acute lymphocytic leukemia (blast or stem cell) (ALL).
      a. Peak occurrences: around 4 years of age, then again around 65 years.
      b. Favorable prognosis with chemotherapy.
      a. Most common in older adults.
      b. Peak incidence age 60 to 70 years.
   3. Chronic myelogenous leukemia (CML).
      a. Uncommon before the age of 20 years; peak incidence age 45 years.
      b. Onset is generally slow.
      c. Symptoms are less severe than those in acute stages of disease.
      d. Presence of Philadelphia chromosome in 90% of cases.
   4. Chronic lymphocytic leukemia (CLL).
      a. Common malignancy of older adults; rare before age 30, and more common in men.
      b. Frequently asymptomatic; often diagnosed in a chronic fatigue work-up.

**Assessment**

A. Clinical manifestations.
   1. Anemia, infection, and bleeding tendencies occurring together.
   2. Anorexia, weight loss, cough.
   3. Central nervous system involvement: headache, confusion, increased irritability.
   4. Fatigue, lethargy.
   5. Petechiae, bruises easily, epistaxis.
   7. Hepatomegaly and splenomegaly.
B. Diagnostics (see Appendix 14-1).
   1. Bone marrow aspiration: increased numbers of blast (immature) cells.
   2. Lumbar puncture to identify presence of leukemic cells in spinal fluid.
   3. Complete blood count.
   4. Studies to evaluate liver and renal function; most chemotherapy agents are detoxified in the liver and excreted by way of the renal system; these systems need to be evaluated before chemotherapy is initiated.

**Treatment**

A. Medications.
   1. Corticosteroids.
   2. Antineoplastic agents (see Appendix 8-1).
   3. Xanthine-oxidase inhibitor: allopurinol (Zyloprim) decreases uric acid levels in clients receiving (see Appendix 21-2).
   4. Chemotherapy usually involves an induction phase, a consolidation phase, and a maintenance phase.
   5. A combination of chemotherapy agents is used initially to promote a remission.
   6. Majority of children with ALL will go into remission during the induction phase.
B. Hematopoietic stem cell transplantation (see Appendix 14-4).
C. A remission is characterized by absence of leukemic cells and disappearance of all disease symptoms.
**Nursing Interventions**

**Goal:** To prevent infection.
A. Systematically assess for evidence of infection: fever, inflammation, pain.
B. Monitor temperature elevation closely; notify doctor of increase above 100.5°F (38°C).
C. Meticulous skin care, especially oral hygiene and around perianal area.
D. Protect client from exposure to infection; degree of restriction depends on immunosuppression.
E. Isolate client from persons with communicable childhood diseases, especially those with chicken pox.
F. Polio (IPV), varicella, measles-mumps-rubella, and influenza immunizations are not recommended to be given to children or adults during immunosuppression.
G. Avoid urinary catheterization if possible.
H. Encourage adequate protein and calorie intake, low-bacteria diet.
I. Maintain adequate hydration.

**NURSING PRIORITY** Prevention and early treatment of common infections is a priority in the care of this client.

**Goal:** To prevent or limit bleeding episodes (Box 14-1).
A. Use local measures to control bleeding (pressure to area; cold packs).
B. Restrict strenuous activity.

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**Box 14-1 BLEEDING PRECAUTIONS**

Indications: Clients diagnosed with leukemia, hemophilia, or any condition that causes bleeding; clients receiving anticoagulants or thrombolytic medications.
- Limit number of venipunctures and intramuscular injections. Perform guaiac tests on stool as necessary.
- Oral hygiene:
  - Discourage flossing.
  - Use soft toothbrush or no toothbrush; may need to use cotton-tipped swabs while gums are friable.
  - Avoid harsh mouthwashes.
  - Rinse mouth frequently with mild mouthwash.
- Use electric razor for shaving.
- Assess perianal area for fissures and bleeding daily.
- Discourage client from vigorous coughing or nose blowing.
- Avoid aspirin products; evaluate NSAIDs for bleeding properties.
- Avoid catheters (urinary and suctioning) when possible.
- Avoid enemas and suppositories.
- Avoid overinflation of blood pressure cuff or leaving cuff inflated for prolonged period of time.
- Provide safe environment and prevent injury according to age (padded side rails, soft toys, house shoes, etc.).
- Monitor for bleeding episode: nosebleed, hematuria, increased bruising.

**ALERT** Care of client receiving chemotherapy, blood transfusions, client and family teaching, and pain relief are all components of the exam.

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**Home Care**

A. Do not take aspirin or medications that contain aspirin.
B. Monitor weight gain or loss.
C. Counseling to determine effect of client’s or child’s illness on family members.
D. Encourage family involvement in client’s care.
E. Discourage pets (e.g., fish, birds, cats) because of the possibility of bacteria and virus transmission.
F. Teach family methods to stop bleeding.
G. Help parents prepare for their child’s return to school.
H. Teach the importance of good handwashing and other infection prevention measures.
I. Teach family members to recognize the early signs of infection and importance of reporting these signs as soon as they are observed.
J. Provide information about community resources for the client and family—e.g., Leukemia Lymphoma Society, American Cancer Society, Meals on Wheels.

*NSAIDs*, Nonsteroidal antiinflammatory drugs.
**Alert** Help the family manage care of a client with long-term needs; determine the family’s understanding of causes of illness; determine effectiveness of the client’s support system.

**Lymphomas**

Characterized by malignant neoplasms originating in the bone marrow and lymphocytes. Lymphoma is the fifth most common type of cancer in the U.S.

A. Hodgkin’s disease: characterized by painless enlargement of lymph nodes with progression to involve the liver and spleen. Common metastatic sites are the spleen, liver, bone marrow, and lungs. Disease is spread by extension along the lymphatic system. This is the most curable of the lymphomas.

1. Assessment.
   a. Risk factors/etiology.
      (1) Familial tendency, more prevalent in men than in women.
      (2) May be caused by Epstein-Barr virus or exposure to occupational toxins.
      (3) Increased incidence in immunosuppressed clients.
   b. Clinical manifestations.
      (1) Initially, painless enlargement of cervical, axillary, inguinal, or mediastinal lymph nodes.
      (2) Symptoms result from pressure on adjacent organs.
      (3) Fever, malaise, night sweats.
      (4) Weight loss and fatigue are associated with a poor prognosis.
      (5) Ingestion of small amounts of alcohol cause pain at affected lymph node sites.
   c. Diagnostics: lymph node biopsy specimen showing presence of Reed-Sternberg cells.

2. Treatment: chemotherapy and radiation.

B. Non-Hodgkin’s lymphoma: a neoplastic growth (derived from B and T cells) that originates in the lymphoid tissue. It spreads malignant cells unpredictably, infiltrating the lymphoid tissue.

1. Assessment.
   a. Risk factors/etiology.
      (1) Increased incidence in clients with immunodeficiency or autoimmune conditions who have used immunosuppressant medications.
      (2) Associated with viral infections (Epstein-Barr) and occupational exposure to carcinogens.
   b. Clinical manifestations.
      (1) Symptoms are highly variable, depending on where the disease has spread.
      (2) Lymphadenopathy that can wax and wane.
   c. Diagnostics: based on classification system of the histopathology of malignant cells.

2. Treatment: chemotherapy and radiation.

**Multiple Myeloma (Plasma Cell Myeloma)**

A malignancy of plasma cells, specifically the B lymphocytes. Infiltration occurs in the bones and soft tissues.

**Assessment**

A. Clinical manifestations.
   1. Back pain, bone pain (pelvis, spine and ribs most common).
   2. Pathologic fractures as a result of diffuse osteoporosis.
   3. Hypercalcemia, high serum protein levels.
   4. Renal failure.

B. Diagnostics.
   1. Serum and/or protein electrophoresis; increased Bence-Jones protein in urine.
   2. Bone marrow biopsy (see Appendix 14-1).
   3. X-ray film showing typical punched-out appearance of the bones caused by demineralization.
   4. Prognosis is based on beta-2-microalbuminuria and albumin.

**Treatment**

A. Chemotherapy (see Table 8-2) and immunomodulators (see Appendix 23-3).
B. Palliative radiation therapy.

**Nursing Interventions**

**Goal:** To maintain physiologic equilibrium.

A. Careful ambulation to decrease hypercalcemia and improve pulmonary status.
B. Adequate hydration to prevent calcium from precipitating in the kidneys; careful monitoring of hydration status.
C. Comfort measures and analgesics for pain.
D. Safety measures to prevent pathologic fractures.

1. Do not lift anything weighing more than 10 pounds.
2. Use proper body mechanics.
E. Braces may be necessary to support the spine.
F. Prevention of infection.

**Goal:** To help the client understand implications of the disease and measures to maintain health.

**DISORDERS OF COAGULATION**

**Hemophilia**

Hemophilia is a defect in the clotting mechanism. Clinically, there are two types, distinguishable only by laboratory tests. Clinically, the two types are the same, but both may occur in varying degrees of severity. The disease is most often recognized during the toddler stage.

A. Hemophilia A: factor VIII deficiency (classic hemophilia).
B. Hemophilia B: factor IX deficiency (Christmas disease).

**Assessment**

A. Risk factors/etiology: both types of hemophilia are sex-linked recessive disorders.
   1. Primarily affects males.
   2. Females are carriers.
B. Clinical manifestations.
   1. Persistent or prolonged bleeding that occurs from minor trauma/insults.
   2. Hemarthrosis: bleeding into joint cavities.
   3. Spontaneous hematuria.
   4. Hematoma.
   5. Intracranial hemorrhage may be fatal.
   6. Petechiae are uncommon, because platelet count is normal.
C. Diagnostics.
   1. History of bleeding episodes.
   2. Family inheritance pattern.
   3. Identification of deficient factor (factor assay).
   4. PTT, bleeding time.

**Treatment**

A. Factor VIII concentrate: must be reconstituted with sterile water immediately before administration; given IV push over 5–10 minutes.
B. Desmopressin (DDAVP, Stimate): synthetic vasopressin used to treat mild cases; given IV or intranasal.
C. Treatment may be carried out at home.

**Nursing Interventions**

**Goal:** To prevent spontaneous bleeding episodes (see Box 14-1).

A. Decrease risk for injury.
   1. Make environment as safe as possible without hampering motor development.
   2. Instruct client to avoid contact sports, but encourage noncontact sports (e.g., swimming).
   3. Regular exercise and physical therapy to promote muscle strength around joints and decrease bleeding episodes.
B. Preventive dental care, and prevent oral infections.

C. Maintain normal weight; increased weight causes increased strain on the joints.
D. Avoid any aspirin compounds.
E. Administer clotting factors before, during, and after invasive medical procedures.

**Goal:** To recognize and treat bleeding episodes.

A. Apply pressure to the area.
B. Immobilize and elevate the joints involved.
C. Do not perform passive range of motion on affected joints.
D. Apply cold pack to promote vasoconstriction.
E. Observe for signs of internal bleeding: tarry stools, slurred speech, headache.
F. Administer clotting factors in a timely manner.

**Goal:** To prepare client and family to administer clotting factors intravenously at home.

A. Correct technique for venipuncture.
B. Indications for use.
C. Encourage child to learn self-administration, generally around age 9 to 12 years.

**Goal:** To prevent permanent joint degeneration.

A. Elevate joint and immobilize during acute bleeding episode.
B. Encourage active range of motion so child will limit movement based on pain tolerance.
C. Physical therapy after the acute phase, no weight bearing until swelling has resolved.
D. Maintain pain relief during physical therapy.

**NURSING PRIORITY** Apply RICE to the affected joints: rest, ice, compression, elevation.

**Home Care**

A. Have client and family demonstrate ability to perform IV puncture.
B. Have client and family discuss situations that call for use of IV infusion of deficient factor: endoscopy, dental work, etc.
C. Discuss with family the importance of routine prophylactic dental checkups.
D. Encourage ventilation of feelings regarding diagnosis of the disease.
E. Encourage counseling for parents regarding concern and guilt over hereditary disorder.

**DISSEMINATED INTRAVASCULAR COAGULATION**

Disseminated intravascular coagulation is a secondary coagulation disorder involving widespread clotting in the...
small vessels, leading to consumption of clotting factors, thereby precipitating a bleeding disorder. It is not a disease but a result of underlying conditions.

**Assessment**

A. Risk factors/etiology.
   1. Increase in release of coagulation factors into circulation: hemolytic processes, extensive tissue damage.
   2. Damage to the vascular endothelium (burns, transplant rejection).
   4. Infection: sepsis.

B. Clinical manifestations.
   1. Thrombocytopenia: petechiae, ecchymosis on skin and mucous membranes.
   2. Prolonged bleeding from multiple body areas.
   3. Hypotension leading to shock.
   4. Multiple organ dysfunction syndrome.

C. Diagnostics (see Appendix 14-1).
   1. Low fibrin and platelet levels.
   2. Prolonged prothrombin time (PT), partial thromboplastin time (PTT), and activated partial thromboplastin time (aPTT).
   3. Elevated fibrin split products (FSPs), and D-dimer assay.

**Treatment**

A. Correction of the underlying problem.
B. Platelets, fresh frozen plasma transfusions, cryoprecipitate based on precipitating cause.
C. Heparin or low-molecular-weight heparin (Lovenox)—use is controversial.
D. Recombinant human activated protein C: drotrecogin alfa (Xigris)—anticoagulant and antiinflammatory effects.
E. Treatment of shock, as indicated.

**Nursing Interventions**

**Goal:** To identify the problem early and to decrease potential adverse effects.
A. Thorough assessment of bleeding problems in clients severely compromised by other problems (shock and sepsis).
B. Nursing measures to prevent bleeding episodes (see Box 14-1).
C. Assess and support all vital systems.

**Goal:** To help the client’s family understand the implications of the disease and demonstrate appropriate coping behaviors.
A. Provide emotional support and encourage visiting as intensive care policies and client’s condition allow.
B. Encourage ventilation of feelings regarding critical illness of family member.
C. Be available to family members during visiting time.

**DISORDERS OF THE SPLEEN**

The spleen is affected by many disorders that can result in splenomegaly (enlarged spleen). The spleen usually contains 20 to 40 mL of blood and does not serve as a reservoir for blood volume or red blood cells.

**Assessment**

A. Risk factors/etiology for splenomegaly.
   1. Chronic myelogenous leukemia.
   2. Heart failure.

B. Clinical manifestations.
   1. Hypersplenism: splenomegaly with peripheral cytopenias (anemia, leukopenia, thrombocytopenia).
   2. Pain due to splenomegaly.
   3. Splenic rupture from trauma or inadvertent tearing during other surgical procedures.

C. Diagnostics (see Appendix 14-1).
   1. Pitted or pocked RBCs or Howell-Jolly bodies.
   2. Spleen scan.

**Treatment**

A. Splenectomy.
B. Analgesics for pain.
C. Platelets, fresh frozen plasma transfusions.

**Nursing Interventions**

**Goal:** To identify the problem early (splenomegaly, hypersplenism, or splenic rupture) and to decrease potential adverse effects.
A. Thorough assessment of spleen problem and management to address issues of splenomegaly (pain), hypersplenism, or splenic rupture (emergency surgery).
B. Nursing measures to prevent bleeding episodes in hypersplenism (see Box 14-1).
C. Assess and support all vital systems.
D. Monitor for complications following surgery—hemorrhage, shock, fever, abdominal distention, immunologic deficiencies (IgM), infection.

**Goal:** To help the client’s family to understand the implications of the problem and demonstrate appropriate coping behavior.
A. Provide emotional support and encourage visiting as intensive care policies and client’s condition allow.
B. Encourage ventilation of feelings regarding critical illness of family member.
C. Be available to family members during visiting time.
D. Teach about lifelong risk for infection following splenectomy; encourage vaccination for pneumococcus.
<table>
<thead>
<tr>
<th>TEST</th>
<th>NORMAL</th>
<th>CLINICAL AND NURSING IMPLICATIONS</th>
</tr>
</thead>
</table>
| Bone marrow aspiration   | All formed cell elements within normal range (erythrocytes, leukocytes, and platelets). | 1. Evaluates presence, absence, or ratio of cells characteristic of a suspected disease (e.g., hematopoiesis pathology, chromosomal abnormalities).  
2. Preferable site is posterior iliac crest; alternate sites are sternum and anterior iliac crest.  
3. Client preparation:  
   a. Local anesthetic is used, as well as analgesics or conscious sedation.  
   b. Feeling of pressure when bone marrow is entered; pain occurs as marrow is being withdrawn.  
4. After test:  
   a. Observe for bleeding at site.  
   b. Apply pressure to site 5 to 10 minutes or longer if client is thrombocytopenic.  
   c. Bed rest for approximately 30 min afterward.  
   d. Analgesics as indicated.  
   e. Monitor for infection. |
| Biopsy                   |                                                                        |                                                                                                    |
| Sickle cell test         | No hemoglobin S present.                                              | 1. Routine screening test for sickle cell trait or disorder; does not distinguish between them.  
2. False-negative result in infants <3 months.  
3. False-positive result can occur for up to 4 months after a transfusion of RBCs that are positive for the trait. |
| (SICKLEDEX)              |                                                                        |                                                                                                    |
| Hemoglobin electrophoresis | Separates various hemoglobins and allows for identification of specific problem. | 1. Differentiates between trait or disorder in sickle cell anemia.  
2. Diagnosis of thalassemia and hemolytic anemia. |
| Activated partial        | Normal 30-45 sec.                                                      | 1. Sensitive in monitoring heparin; draw 1 hour before next heparin dose.  
2. May be used to detect circulating anticoagulants. |
| thromboplastin time       |                                                                        |                                                                                                    |
| (aPTT)                   |                                                                        |                                                                                                    |
| Prothrombin time (PT)    | 12 to 15 sec or 100% (each client will have a control value).          | 1. Production of prothrombin depends on adequate intake and utilization of vitamin K. |
| International normalized | Normal INR is 1.0-2.0.                                                 | 2. Both tests may be used in management of Coumadin therapy.  
3. INR should be maintained at 2.0–3.0 for individuals with risk for clots (atrial fibrillation, history of recent DVT) and 2.5–3.5 for individuals with mechanical heart valves. |
| ratio (INR)              |                                                                        |                                                                                                    |
| Fibrin split products    | Normal less than 10 mg/L or less than 10 mcg/mL.                       | 1. Fibrinolysis occurs in intravascular coagulation.  
2. Abnormally high levels in DIC. |
| Homocysteine             | Normal 8-20 µmol/L.                                                   | 1. An amino acid metabolized through pathways that require vitamin B₁₂.  
2. Increased in B₁₂ and folic acid deficiency. |
| D-dimer                  | Normal less than 250 ng/mL.                                           | 1. Used to measure fibrin fragment created by fibrin degradation and clot lysis.  
2. Used in management of low-molecular-weight heparin therapy. |
| Ferritin                 | Normal 10-300 ng/mL                                                  | 1. Major iron storage protein reflects iron storage. |

DIC, Disseminated intravascular coagulation; DVT, deep venous thrombosis; RBCs, red blood cells.
### Appendix 14-2  HEMATOLOGIC MEDICATIONS

<table>
<thead>
<tr>
<th>MEDICATIONS</th>
<th>SIDE EFFECTS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Iron Preparations</strong></td>
<td>Replacement.</td>
<td></td>
</tr>
<tr>
<td>Ferrous fumarate (Feostat, Span 77, FEM Iron): PO</td>
<td>GI irritation, Nausea</td>
<td>1. Absorbed better on empty stomach; however, may give with meals if GI upset occurs.</td>
</tr>
<tr>
<td>Ferrous gluconate (Fergon, Ferralet): PO</td>
<td>Constipation, Toxic reactions: Fever</td>
<td>2. Liquid preparations should be diluted and given through a straw to prevent staining of the teeth.</td>
</tr>
<tr>
<td>Ferrous sulfate (Fesol, Fer-In-Sol): PO</td>
<td></td>
<td>3. Tell client stool may be black and iron may cause constipation.</td>
</tr>
<tr>
<td>Iron dextran injection (InFeD, Dexferrum): IV, IM</td>
<td>GI irritation, Nausea</td>
<td>4. Eggs, milk, cheese, and antacids inhibit oral iron absorption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Iron preparations inhibit oral tetracycline absorption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• IM/IV preparations may be used if on oral tetracycline.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Anaphylactic reaction can occur; test dose should be given.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• IM should be avoided because of pain and tissue discoloration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If given IM, use Z-track method to prevent tissue staining.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• IV route recommended if oral route is not acceptable.</td>
</tr>
</tbody>
</table>

**Vitamin K**  Necessary for normal prothrombin activity.

<table>
<thead>
<tr>
<th>MEDICATIONS</th>
<th>SIDE EFFECTS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin K: phytonadione (AquaMEPHYTON): PO, subQ, IM, IV</td>
<td>GI upset, rash</td>
<td>1. PO and subQ most common routes.</td>
</tr>
<tr>
<td></td>
<td>IV not recommended because of hypersensitivity reactions</td>
<td>2. Antidote for Coumadin.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Observe bleeding precautions.</td>
</tr>
</tbody>
</table>

*GI*, Gastrointestinal; *IM*, intramuscularly; *IV*, intravenously; *PO*, by mouth (orally); *SQ*, subcutaneously.

### Appendix 14-3  BLOOD TRANSFUSIONS

<table>
<thead>
<tr>
<th>BLOOD COMPONENT FOR TRANSFUSION</th>
<th>PURPOSE OF ADMINISTRATION</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packed RBCs: 200-250 mL per unit</td>
<td>To increase oxygen-carrying capacity.</td>
<td>1. Chart:</td>
</tr>
<tr>
<td></td>
<td>To decrease risk for incompatible antibodies from the plasma.</td>
<td>Time started and time completed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rate of infusion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blood unit identification number.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Vital signs are taken immediately before transfusion, at 5 min and 15 min into transfusion, every hour during transfusion, and at completion of transfusion.</td>
</tr>
<tr>
<td>Platelets: 50-70 mL per unit</td>
<td>To treat thrombocytopenia.</td>
<td>3. Closely observe older adult clients for indications of fluid overload.</td>
</tr>
<tr>
<td>Fresh frozen plasma: 200-250 mL per unit</td>
<td>Administered for clotting factors, proteins, fluid volume.</td>
<td>1. Chart amount and type of infusion.</td>
</tr>
<tr>
<td>Whole blood: 500 mL per unit</td>
<td>To provide volume replacement and increase oxygen. Administered with greater than 25% blood loss.</td>
<td>2. Observations for fluid volume overload.</td>
</tr>
</tbody>
</table>

**ALERT**  Administer and discontinue blood and/or blood products; check blood products according to institution policies; evaluate appropriate IV access; evaluate client’s response.
Nursing Guidelines for Packed RBCs or Whole Blood Transfusions

1. Informed consent and alternatives should be explained to the client. Autologous (using client’s own blood) and designated donor transfusions are options. If client is unable to give consent, consent should be obtained from family.
2. Obtain the type and cross-match records and the unit of blood to administer.
   a. Check: The ABO group on the unit against the cross-match record.
   b. The Rh type of the blood against the cross-match record.
   c. Have two RNs independently—or one RN and one physician—check the records and sign that they have checked them.
   d. Check the client’s name and hospital number on the unit of blood and on the cross-match record.
   e. If any of the above do not match, DO NOT GIVE THE BLOOD.
   f. Check the expiration date on the unit of blood.
3. Administer the blood immediately after receiving it from the blood bank; blood should NEVER be stored in a unit refrigerator or allowed to sit out at room temperature. The maximum amount of time blood can be out of monitored storage is 30 min.
4. Do not add any medications to blood products.
5. Do not warm blood before transfusion, unless there are several units to be infused rapidly and client is in danger of developing a hypothermic response. If blood must be warmed, use equipment that is specifically designed for this procedure.
6. DO NOT use a microwave to warm the blood.
7. Inspect the blood bag for leaks, abnormal color, excessive air, or bubbles.
8. The average rate of transfusion in an adult is 1 unit of blood over about 3 to 4 hours, depending on the condition of the client.
9. The blood administration set should be changed after 2 units have infused to decrease risk for bacterial contamination.
10. It is not recommended to use an infusion pump; the pump increases RBC hemolysis.
11. Multiple transfusions can result in hypocalcemia.

Nursing Guidelines for Platelets and Fresh Frozen Plasma

1. Obtain type and cross-match records; check client and unit identification in same way as for packed RBCs.
2. Unit should not contain any clumps or have unusual color.
3. Fresh frozen plasma must be administered immediately.
4. Infuse each unit as fast as client will tolerate.

**NURSING PRIORITY** The majority of major adverse transfusion reactions are due to improper identification of the blood product and the recipient.

**KEY POINTS: Guidelines for Performance**

**Phase of Transfusion**

- Check the doctor’s order; check the labels on the blood bag against the client identification at the bedside.
- Baseline vital signs must be obtained before hanging the blood; if the client has a temperature above 101° F, advise the physician before starting the transfusion.
- Initiate the infusion with an 18-gauge or 20-gauge needle and begin infusing normal saline solution.
- Do NOT use D5W to initiate the transfusion; it causes the blood to hemolyze and precipitate.
- Always use a standard blood administration set with a filter; DO NOT use straight IV tubing.
- Initiate infusion (rate of approximately 100 mL/hr, depending on client’s condition) and remain with the client; the first 10-15 min is the most critical period of time; the majority of transfusion reactions occur during administration of the first 50 mL.
- During the transfusion, continue to monitor for circulatory overload or transfusion reaction.
- Blood deteriorates rapidly after about 2 hr or exposure to room temperature; a unit of blood should not hang longer than 4 hr.
- Components (plasma, platelets) that contain few RBCs may be administered rapidly.

---

**TRANSFUSION REACTIONS**

**Hemolytic Transfusion Reaction**

1. Low back pain
2. Hypotension, tachycardia, tachypnea
3. Apprehension, sense of impending doom
4. Fever, chills, flushing
5. Chest pain
6. Dyspnea
7. Onset is immediate

**Allergic Reaction**

1. Urticaria (hives)
2. Pruritus
3. Facial flushing
4. Severe shortness of breath, bronchospasm

**NURSING MANAGEMENT**

1. If client has a history of allergic reactions, antihistamines may be given before starting the transfusion.
2. Stop transfusion until status of reaction can be determined; if symptoms are mild and transient, the transfusion may be resumed.
TRANSFUSION REACTIONS

Febrile Reaction
1. Chills and fever
2. Headache, flushing
3. Muscle stiffness/pain
4. Increased anxiety

NURSING MANAGEMENT
1. Keep client covered and warm during transfusion.
2. Stop the transfusion until status of reaction can be determined.
3. Transfusion with leukocyte-poor RBCs or frozen washed packed cells may prevent this reaction in clients susceptible to fever.
4. Most common reaction.

\[D, W; 5\% \text{ Dextrose in water; } IV; \text{ intravenous; RBCs, red blood cells; RN, registered nurse.}\]

Appendix 14-3  BLOOD TRANSFUSIONS—cont’d

Goal: To restore hematologic and immunologic function in clients with immunologic deficiencies, leukemia, congenital or acquired anemias.

Procedure
In the adult client, approximately 400 to 800 mL of bone marrow or harvested stem cells are processed and transfused into the client. (See Appendix 14-1 for care of donor client for bone marrow aspiration.)
1. Typing:
   a. Allogenic: matching of a histocompatible donor, preferably a relative.
   b. Autologous: uses client’s own bone marrow that has been collected from disease-free tissue and then frozen.
   c. Syngeneic: donor is an identical twin with perfect tissue match.
2. Immunoablative preparation pretransplant: chemotherapy and radiation to produce immunologically suppressed state before the hematopoietic transfusion; procedure takes 5 to 10 days.

Complications
1. Bacterial, viral, or fungal infection from immunosuppressed state.

2. Severe thrombocytopenia resulting in bleeding problems.
   a. Acute rejection generally occurs in 7 to 30 days after transplantation; chronic rejection occurs in 100 days.
   b. Erythematous rash on the palms and feet, spreading to the trunk, may be an early symptom.
   c. Altered liver enzyme profiles with liver tenderness and jaundice.
   d. Gastrointestinal disturbances: anorexia, nausea, vomiting, diarrhea.

Nursing Implications
1. Preparation of the client for immunosuppression with chemotherapy and radiation therapy.
2. Confirmation of rejection is by skin or oral mucosal biopsy.
3. Successful engraftment is indicated by formation of erythrocytes, leukocytes, and platelets, usually 2 to 5 weeks after transplantation.
4. Care of the immunosuppressed client (see Chapter 7).

Appendix 14-4  HEMATOPOIETIC STEM CELL TRANSPLANT*

*Includes bone marrow transplant and stem cell transplant.
1. A client and her husband are positive for the sickle cell trait. The client asks the nurse about the chances of her children having sickle cell disease. The nurse understands that this genetic problem will reflect what pattern in the client’s children?
   1. One of her children will have sickle cell disease.
   2. Only the male children will be affected.
   3. Each pregnancy carries a 25% chance of the child being affected.
   4. If she has four children, one of them will have the disease.

2. The nurse is preparing discharge teaching for a client with aplastic anemia. What will be important to include in the teaching plan? Select all that apply:
   ______ 1. Take your iron with meals every day and increase the amount of green, leafy vegetables in your diet.
   ______ 2. Establish a balance between rest and activity; avoid excessive fatigue.
   ______ 3. Rest and supplemental oxygen may be required during periods of dyspnea.
   ______ 4. Drink a glass of wine in the evening to help increase your appetite.
   ______ 5. Notify your health care provider if you begin to experience frequent bruising.
   ______ 6. Increase your intake of dairy products (milk and cheese) and protein.

3. A client is experiencing a sickle cell crisis during labor and delivery. What is the best nursing action?
   1. Maintain IV fluid infusion and assess adequacy of hydration.
   2. Administer a high concentration of oxygen.
   3. Insert a Foley catheter and monitor hourly urine output.
   4. Provide continuous sedation for pain relief.

4. The nurse is preparing a teaching plan for a family with a child who has been diagnosed with sickle cell anemia and crisis. What will the nurse include in the teaching regarding the pathophysiology of sickle cell crisis?
   1. It results from altered metabolism and dehydration.
   2. Tissue hypoxia and vascular occlusion cause the primary problems.
   3. Increased bilirubin levels will cause hypertension.
   4. There are decreased clotting factors with an increase in white blood cells.

5. A young woman comes to the clinic complaining of dizziness, weakness, and palpitations. What will be important for the nurse to evaluate initially when obtaining the health history?
   1. Activity and exercise patterns
   2. Nutritional patterns
   3. Family health status
   4. Coping and stress tolerance

6. A child with leukemia is being discharged after beginning chemotherapy. What instructions will the nurse include in the teaching plan for the parents of this child?
   1. Provide a diet low in protein and high in carbohydrates.
   2. Avoid fresh vegetables that are not cooked or peeled.
   3. Notify the doctor if the child’s temperature exceeds 101° F (39° C).
   4. Increase the use of humidifiers throughout the house.

7. Which client is most likely to have iron deficiency anemia?
   1. A client with cancer receiving radiation therapy twice a week.
   2. A toddler whose primary nutritional intake is milk.
   3. A client with a peptic ulcer who had surgery 6 weeks ago.

8. A client with hemophilia comes to the emergency department after bumping his knee. The knee is rapidly swelling. What is the first nursing action?
   1. Initiate an IV site to begin administration of cryoprecipitate.
   2. Perform a type and cross-match for possible transfusion.
   3. Draw blood for determination of hemoglobin and hematocrit values.
   4. Apply an ice pack and compression dressings to the knee.

9. A client has an order for one unit of packed cells. What is a correct nursing action?
   1. Initiate the IV with 5% dextrose in water (D5W) to maintain a patent access site.
   2. Initiate the transfusion within 30 minutes of receiving the blood.
   3. Monitor the client’s vital signs for the first 5 minutes.
   4. Monitor the client’s vital signs every 2 hours during the transfusion.

10. The nurse is caring for a client who is receiving a blood transfusion. The transfusion was started 30 minutes ago at a rate of 100 mL/hr. The client begins to complain of low back pain and headache and is increasingly restless. What is the first nursing action?
    1. Slow the infusion and evaluate the vital signs and the client’s history of transfusion reactions.
    2. Stop the transfusion, disconnect the blood tubing, and begin a primary infusion of normal saline solution.
    3. Stop the infusion of blood and begin infusion of normal saline solution from the Y connector.
    4. Recheck the unit of blood for correct identification numbers and cross-match information.

Answers and rationales to these questions are in the section at the end of the book titled Chapter Study Questions: Answers and Rationales.