Hematology

Functions of Blood

- What are the functions of the blood?
  - Carries oxygen to the cells
  - Carries carbon dioxide away
  - Transports: Water, electrolytes, hormones, enzymes
  - Provides clotting factors
  - Assists with heat regulation
**Structures of Blood**

- **Plasma**: Straw colored fluid, 90% water. This is the vehicle for the blood cells to be transported throughout the body.
- **Erythrocytes (Red blood cells)**: Contain red, iron-rich complex. RBCs live approximately 2-4 months.
  - Hemoglobin (Hgb): Binds to O2.
  - Hematocrit: Measures volume of RBCs
- **RBCs** are biconcave disks and are formed in the red bone marrow.
- **Erythropoiesis** is the process of the erythrocyte production.
- **Erythropoietin** is a hormone produced in the kidneys which stimulates and regulates the production of RBCs.
- Important to remember that patients with kidney disease may have decreased RBCs.

- **Leukocytes (White blood cells) WBCs**: Defend against invading bacteria, viruses, fungus.
  - **Granulocytes**: "Grainy cells" that contain cells with granules within the cytoplasm.
  - **Agranulocytes**: Cells that do not have granules within the cytoplasm.
Granulocytes

- Neutrophils: phagocytes that ingest and digest debris and foreign material. First line of defense against bacteria. Mature neutrophils are segmented and known as segs or polys, and immature neutrophils are unsegmented and called bands or stabs.
- Eosinophils: Weak phagocytes but good at detoxifying allergens and parasites.
- Basophils: Secrete histamine which mediate systemic hypersensitivity reactions.

Agranulocytes

- Monocytes: In size are the largest macrophages which clean up WBC debris and substances that “mark” invading organisms for lymphocytes to destroy.
- Lymphocytes: Originate in bone marrow. They react to a specific infecting agent.
  - T cells: attack foreign cells that have been invaded by viral infections
  - B cells: produce antibodies

- Platelets (Thrombocytes): Are formed in the red bone marrow.
  - Control bleeding
  - Repair injured vessels
- Plasma protein fractions:
  - Globulin: circulating antibodies after having a specific disease or immunization.
  - Serum albumin: maintains osmotic pressure of the plasma. May be administered to patients in treatment of burns, severe liver disease, hypovolemic shock.
  - Fibrinogen: essential clotting factor
  - Cryoprecipitate: Contains clotting factors XIII and VI (8 & 9)
Normal Blood Values

- **WBC**: 5,000 – 10,000
- **Differentials**: Absolute Values % of total
  - **Granulocytes**:
    - Neutrophils: 3,000 – 7,000 60 – 70%
    - Eosinophils: 50 – 400 1 – 4%
    - Basophils: 25 – 100 .05 – 1%
  - **Agranulocytes**:
    - Lymphocytes: 1,000-4,000 20 - 40%
    - Monocytes: 100 – 600 2 – 6%

Cont. blood values

- **Red Blood cells**: 4.5 – 6.0 million/mm³
  - Hemoglobin: 12 – 18 g/ml
  - Hematocrit: 38% - 48%
- **Platelets**: 150,000 – 400,000

Red Blood Cell Indices

- **Mean Corpuscular Volume (MCV)**: The description of individuals cell size and is the best index for classifying anemias. Expresses the volume occupied by a single red cell.
- **Mean Corpuscular Hemoglobin Concentration (MCHC)**: The measure of the average concentration of hemoglobin in the RBCs. Most valuable in evaluating the therapy for anemia because the two most accurate hematologic determinations are used for calculating this test.
- **Mean Corpuscular Hemoglobin (MCH)**: A measure of the average weight of hemoglobin in the RBCs. Is of value in diagnosing severely anemic patients.
Diagnostic tests

• Coagulation – defines the clotting ability
  – PT (prothrombin time) used to help regulate coumadin. Memory jogger: PT = PO
  – PTT (partial prothrombin time) used to help regulate heparin. Memory jogger: PTT = INT
  – Bleeding time amount of time it takes for platelets to form a clot.
• Erythrocyte Sedimentation rate (ESR) – Indicates inflammation and infection
• Blood cultures & sensitivity (C&S) determines specific bacteria and what antibiotic will most effectively treat it.
• Bone marrow aspiration & biopsy – Evaluates the number, size, & shape of the RBCs, WBCs & platelets. Most common site of aspiration- posterior superior iliac crest.
• Lymph node biopsy - Diagnose & stages tumors

Disorders of the Red Blood Cells

General Characteristics of Anemia

• Anemia: A state in which hemoglobin is diminished
• Causes of Anemia
  – Dietary deficiencies
  – Malignancies
  – Bone marrow damage
  – Chronic infections
  – Overactive spleen
  – Bleeding
  – Heredity disorders
Anemia Generic Signs & Symptoms

- Pallor
- Weakness
- Anorexia
- Jaundice
- Hypotension
- Irritability
- Difficulty sleeping
- Menstrual disturbances
- Difficulty concentrating
- Tachycardia
- Dizziness
- GI complaints
- CHF
- Dypsnea
- Impotence
- Hypothermia
- Nausea/vomiting
- Constipation
- Indigestion
- Memory loss
- Tongue – red, sore, smooth
- Tingling hands/feet
- Partial or total paralysis (destruction of nerve fibers of the spinal cord.)

Pernicious Anemia

- The digestive tract fails to absorb B 12.
- Prior to 1928 this anemia was fatal!
- Most affected: middle ages, post gastrectomy patients. (They no longer are able to produce intrinsic factors.)

Assessment for B12 Deficiency

- Onset insidious
- Flatulence
- Jaundice
- Palpitations
- Tongue – red, sore, smooth
- Tingling hands/feet
- Partial or total paralysis (destruction of nerve fibers of the spinal cord.)
Diagnostics & Interventions

- **Diagnostics**
  - **Schilling test, CBC, Bone marrow aspiration**
- **Interventions**
  - B 12 injections (possibly lifelong)
  - Severe forms need blood transfusions of PRBCs
  - Safety
  - Vital signs
  - Monitor LOC
  - Good oral care
  - Avoid hot, spicy foods
  - Keep warm
  - Monitor activity Level

Hemorrhagic Anemia

- Acute - Sudden loss of large amount of blood, ie: trauma, ulcers, childbirth, surgery. Hypovolemia may occur!
- Chronic – Slow loss of blood ie: ulcers, cancer, hemorrhoids
- Volume loss of 20% insufficiency
- Volume loss of 30% circulatory failure, coma
- Volume loss of 40% FATAL in most cases

Assessment of Hemorrhage

- Hypotension
- Fatigue
- Tachycardia
- Cold clammy skin
- Dizziness
- Orthostatic hypotension
- Dyspnea
- Thirst
- Headache
- Confusion
- Drowsy
Diagnosis and Treatment of Hemorrhage

- Diagnosis: CBC, Electrolytes, Assess urine output, Vital signs
- Interventions
  - IV fluid
    - Saline
    - Albumin
    - Plasma
  - Keep warm
  - Frequent vital signs
  - Safety measures
  - Surgery (Possible depending on situation)
  - Iron replacement
  - Elevate FOB

Iron Deficiency (Hypochromic) Anemia

- Anemia which occurs when the amount of iron (Fe) in the body is insufficient to allow the manufacturing of that amount of hemoglobin needed.
- Assessment: Very pale!
  - Fatigue
  - Dypsnea
  - Palpitations

Diagnosis and Interventions

- Diagnostics – CBC, bone marrow aspiration
- Interventions
  - Locate the bleed
  - Surgical intervention as needed
  - Increase Iron (Fe)
    - Supplemental
    - Dietary
      - Eggs, Meat, Apricots, Citrus drinks (help absorb Fe)
Education and FYI

- Iron replacement may last up to six months
- Notify physician if symptoms remain or return
- Take Iron liquid supplements with straw!
- IM injections of Iron must be given Z-track
- Stools may be black or green
- Constipation

Aplastic anemia

- Anemia resulted from bone marrow failure. Decreased production of all types of blood cells. May be congenital or acquired. May be life threatening!
- Causes: Medications, antineoplastics, radiation

Assessment & Interventions of Aplastic Anemia

- Assessment
  - Fatigue
  - Pallor
  - Confusion
  - Infection
  - Fever
  - Headache
  - Increased bleeding
  - Erythrocytopenia
  - Leukopenia
  - Thrombocytopenia
Interventions for Aplastic Anemia

- IDENTIFY THE CAUSE & REMOVE THE TOXINS
- Monitor vital signs
- Safety precautions
- Respiratory care
- Steroids to stimulate bone marrow production
- Reverse Isolation
- Gentle oral care
- Electric razor only
- No needle sticks
- Meticulous hand washing!!
- Bone Marrow transplant
- Frequent oral care
- Turn frequently
- Monitor labwork

Polycythemia

- Polycythemia is an abnormal increase in the amount of circulating RBCs, which increase the blood volume
- Signs & Symptoms
  - Hypertension
  - Headache
  - Pruritis
  - Pain of gouty arthritis
  - Ruddy complexion
  - Bleeding gums
  - Enlarged spleen

Diagnostics and Intervention

- Diagnostics
  - CBC
  - Bone marrow
  - Uric acid
- Interventions
  - Phlebotomy
  - Medications
    - Myelosuppressive agents
    - Pain med
Nursing Interventions for the patient with Polycythemia

• Observe respiratory effort
• Observe for signs of bleeding
• Assist with ambulation
• HOB elevated
• Cool baths
• Encourage fluids
• Decrease iron in the diet
• Observe for
  – Hemorrhage
  – Gout
  – CHF
  – Thrombi
  – Leukemia

Education

• Avoid foods high in Iron
• Avoid high purine foods
• Avoid hot showers
• Avoid getting up quickly after phlebotomy
• Monitor vital signs at home

Sickle Cell Anemia

• Red blood cells are “sickle” or “crescent” shaped
• Causes poor circulation of RBCs
• Obstruct flow of blood causing infarct and/or vessel rupture
• Virtually every system of the body can be adversely affected
Assessment for Sickle Cell Anemia

- Bone & joint pain
- Fatigue
- Dyspnea
- Palpitations
- Dizziness
- Abdominal pain
- Petechiae
- Blurred vision
- Jaundice
- Edema
- Pallor

Diagnostics & Treatment

- CBC
- Hemoglobin S (Sickledex)
- Family genetic history

- Treatment
  - Hydration
  - Pain management
  - Folic acid
  - Oxygen
  - Blood transfusions
  - Skin care

Education for Sickle Cell

- Avoid high altitudes
- Adequate fluids
- Avoid fatigue
- Take medication as prescribed
- Explain to parents
  - Genetic counseling
  - Encourage child to lead normal life
Complications of Sickle cell

• Cerebral infarcts — Stroke
• Pulmonary infarcts
• Pulmonary stasis
• Cardiomegaly
• Heart failure
• Cholelithiasis
• Renal infarcts — Renal failure
• Demands on bone marrow
  — Aplastic crisis
  — Delayed growth
• Vaso occlusion (pain, leg ulcers)
• Hemarthrosis (leakage of blood into joints)

Disorders of the White Blood Cells

Leukemia

• Leukemia — A neoplastic disease involving leukopoietic tissue in either bone marrow or lymphoid areas
• Chronic: Occurs most often later in life.
• Acute: May occur at anytime, but is more aggressive.
• Chronic leukemias
  – (CLL) Chronic lymphocytic leukemia
  – Most common type in persons age 50 and older
  – (CML) Chronic myelogenous leukemia
  – Uncommon before age 20; incidence rises with age

• Acute leukemias
  – (ANLL) Acute nonlymphocytic leukemia
  – Most common in adults; incidence increases with age
  – (ALL) Acute lymphocytic leukemia
  – Most common in children (85%) of all cases & accounts for 90% of childhood leukemias

Etiology of Leukemias
• Etiology is unknown, but certain factors are associated with increased incidence which include:
  – Exposure to radiation
  – Chemical agents (benzene, alkylating chemotherapeutic agents)
  – Infectious agents (Viral)
  – Genetic variables

Assessing patient with Leukemia
• Petechiae, ecchymoses, epistaxis, gingival bleeding, retinal hemorrhages, frank bleeding from any body orifice secondary to thrombocytopenia
• Fatigue, pallor, dyspnea
• Fever s/s of infection
• Anorexia, nausea, weight loss
• Night sweats
• Bone pain
• Enlarged lymph nodes
Diagnostics
- Complete blood count (CBC)
  - White blood count which includes immature cells
  - Elevated leukocyte count
  - Bone marrow aspiration/biopsy

Medical surgical intervention
- Chemotherapy: DANGEROUS SIDE EFFECTS POSSIBLE
- Nutritional intervention
  - IV/HAL/Lipids
  - Tube feedings
- Bone marrow transplant

Nurse interventions for the Patient with Leukemia
- PREVENT INFECTION!!!
  - Good handwashing
  - Reverse isolation
  - Appropriate patient assignment
  - Healthy nurse
  - Know the s/s of infection
- Prevent/control bleeding
- Antibiotic therapy as prescribed by physician
- Good oral care
- Pain control
- Bowel care (must prevent constipation) NO SUPPOSITORIES
- EMOTIONAL SUPPORT
Lymphomas

- Neoplastic diseases of cells of the lymph tissue
- Lymphomas are usually divided into two large sub groups
- Etiology: unknown
- Lymphomas usually originate in lymph nodes and may involve lymph tissue through out the body. Such tissues are:
  - Tonsils
  - Stomach wall
  - Liver
  - Bone marrow

Lymphomas

- Hodgkins
  - One of the most curable forms of cancer
  - Affects people 15 – 35 and over age 51
  - Common sign is painless lymph node usually in the neck
  - Linked to viral infection
  - Predictable pattern of spread
- Non Hodgkins
  - Tend to occur in older adults
  - Tend to occur in people that are immune suppressed
  - Prognosis not as good as person with Hodgkins
  - Bone marrow invasion with possible anemia, thrombocytopenia, and immune dysfunctions

Assessment for Lymphoma

- Palpable lymph nodes, especially cervical, axillae, and groin
- Fatigue
- Weight loss
- Fever
- Chills/night sweats
- Pruritis
Serious Secondary Signs & Symptoms of Invasive Lymphoma

- Dyspnea: Pressure against trachea
- Dysphagia: Pressure on esophagus
- Edema in extremities
- Pleural effusions
- Obstructive jaundice

Diagnostics for Lymphomas

- Lymph node biopsy
- Bone marrow aspiration
- Liver function blood tests
- Liver scan
- Chest x-ray
- Cat scans
- Renal function blood and urine tests
- Renal scan

Medical Surgical Interventions

- Radiation therapy
  - Used in both types of Lymphoma
- Chemotherapy
  - May be a single chemo or combination
- Surgical removal of nodes
Nursing Interventions for Lymphoma

- Maintain skin integrity
  - Pruritis
  - Skin reactions to radiation/chemotherapy
  - Treat fever with antipyretics once infection is ruled out
  - Analgesics for pain
  - Antibiotics as ordered
  - Antiemetics
  - Ensure adequate nutrition and hydration
  - Emotional support to patient and family

Platelet and Coagulation Disorders

Hemophilia

- Bleeding disorder in which there is a lack in clotting factors.
- Type A deficiency in factor VIII (8)
- Type B deficiency in factor IX (9)
- Von Willebrand’s disease
Assessment of Hemophilic

- Joint swelling
- Pain in a joint
- Petechiae/ecchymoses
- Hematuria
- Melena
- Epistaxis
- Frank bleeding
- Abdominal firmness & rigidity

Diagnosis/Treatment

- Diagnostics
  - PT prothrombin time
  - Platelet count
  - Bleeding time
  - PTT partial thromboplastin time
  - Other coagulation studies

Medical treatment Hemophilia

- Treatment
  - Type A
    - Fresh frozen plasma (FFP)
    - Cryoprecipitate
  - Type B
    - Fresh frozen plasma
    - DDAVP
    - Amicar
Nursing Interventions

- Pain control
- Assess bruising
- Oxygen
- Ice and/or pressure at site
- Electric razor
- Soft tooth brush
- Avoid IM injections IF NEEDLE MUST BE USED, APPLY PRESSURE AT SITE FOR 10 MINUTES (or until bleeding has ceased.
- High risk for injury. Keep environment safe

Disseminated Intravascular Coagulation (DIC)

- Coagulation initially within arterioles and capillaries leading to hemorrhage
- Causes
  - OB complications
  - Neoplastic diseases
  - Liver disease
  - Hypovolemic or septic shock
  - Decreased perfusion
    - Infection
    - Injury

Signs & symptoms of DIC

- Petechiae/ecchymosis
- Cyanosis especially fingers and toes
- Bleeding from wounds, venipuncture, body orifices
- Oliguria/anuria
Diagnostics for DIC

- Complete blood count (CBC)
- PT
- PTT
- Platelet count
- Fibrinogen

Medical Surgical Intervention

- ** Treat the underlying problem
  - Shock
  - Infection
  - Delivery
- Medications
  - Antibiotics
  - Anticonvulsive medication
- IV fluids
  - Clotting factors
  - RBCs
  - TPN/Lipids
- Possible ventilator assistance

Nursing Interventions for DIC

- Observe for bleeding
- Observe for ischemia
- Frequent vital signs
- Neuro checks/ Observe for seizure activity
- Observe circulation
- Monitor renal function (I&O)
- Reassure patient and family
**Thrombocytopenia**

- Platelet count of less than 100,000/mL of blood. The most common cause of abnormal bleeding.
- May induce internal and/or external bleeding.
- Primary idiopathic thrombocytopenia purpura (ITP) most common form.
- Purpura = hemorrhage into the tissues
- Petechiae = small flat purple or flat red spots on the skin and mucous membranes

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**Diagnostics & Symptoms**

- **Diagnostics**
  - CBC
  - Platelet count
  - Bone marrow aspiration
- **Symptoms**
  - Bruising
  - Nosebleeds
  - Bleeding from body orifices, surgical sites, needle punctures

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**Medical surgical Treatment for ITP**

- Corticosteriods to suppress the immune system
- Antibiotics as needed
- Platelet transfusion
- Spleenectomy (since the spleen may be destroying the platelets)
Nursing interventions

• Similar to patient with DIC or hemophilia
• Safety
• Observe for possible sources of potential bleeding