Blood Disorders

PART ONE
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Semester 2

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Hematology

- "Study of blood and blood-forming tissues"
- Includes
  - Blood
  - Bone marrow
  - Spleen
  - Lymph system

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Three Types of Blood Cells

- Erythrocytes: RBC's
  - Primary function: 02 transportation
- Leukocytes: WBC's
  - Primary function: fighting infection
- Thrombocytes: Platelets
  - Primary function: promote coagulation

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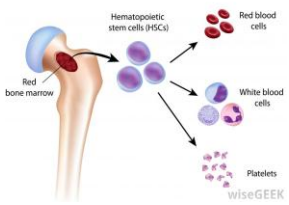
Bone Marrow

- Soft material the fills the central core of bones
- Two types of bone marrow
  - Yellow: Adipose
  - Red: Hematopoietic



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Hematopoiesis: Blood Cell Production

- Occurs within bone marrow
- Found primarily in red marrow
  - Flat & irregular bones
    - End of long bones
    - Pelvic bones
    - Vertebrae/sacrum/sternum

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Hematopoiesis

- Hematopoietic stem cell
  - Develop from immature blood cells in the bone marrow
  - Cells mature & differentiate
    - Develop: RBC's, WBC's & Platelets

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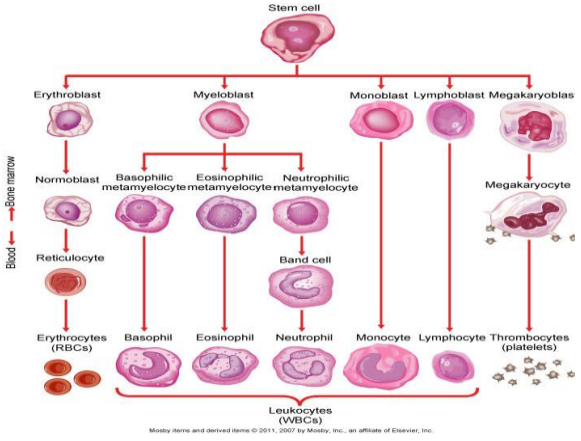

Clinical Significance

- **Tissue Hypoxia Occurs:**
  - Kidneys & liver secrete erythropoietin
  - Erythropoietin circulates to bone marrow
  - Causes differentiation of proerythroblasts in bone marrow

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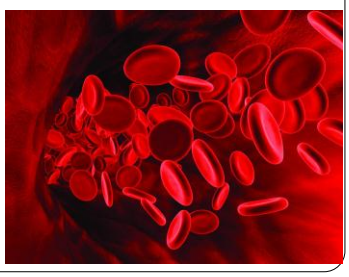
Blood

- Performs three main functions:
  - Transportation
  - Regulation
  - Protection



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Transportation

- Oxygen from lungs to cells
- Nutrients from GI tract to cells
- Hormones from endocrine glands to cells
- Metabolic wastes from cells to lungs, liver & kidneys

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Regulation

- Fluid & electrolyte balance
- Acid base balance
- Body temperature

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Protection

- Maintains homeostasis of blood coagulation
- Combats invasion of pathogens and other foreign substances

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Plasma approx: 55% of blood

- Primarily Water
- Also composed of:
  - Proteins
  - Electrolytes
  - Gases
  - Nutrients
  - Waste products

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Blood Cells approx: 45% of blood

- Erythrocytes (RBC's)
- Leukocytes (WBC's)
- Thrombocytes (Platelets)

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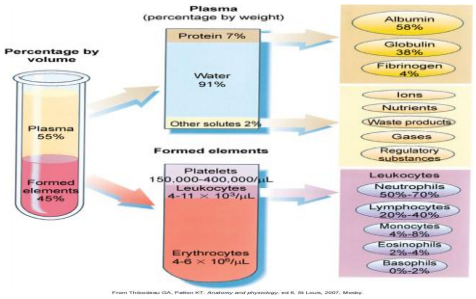
Blood Components



From Thibodeau GA, Patton KT: Anatomy and physiology, ed 6, St Louis, 2007, Mosby.

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Erythropoiesis

- Production is influenced by:
  - Availability of nutrients
    - Protein, iron, folic acid, vitamin's (B2, B6, B12, E), niacin, ascorbic acid, and pantothenic acid
  - Endocrine hormones
    - Thyroxin, corticosteroids & testosterone
      - Hypothyroidism is often associated with anemia

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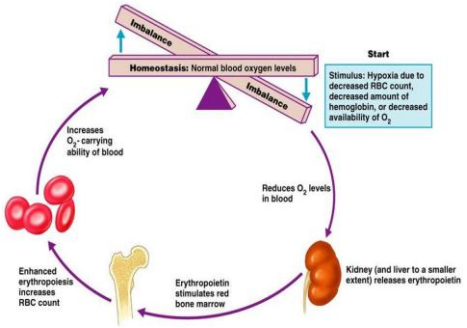
Concept Review



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RBC's Structure

- Lifespan approximately 120 days
- Flexible cell: alters shape to pass through small capillaries

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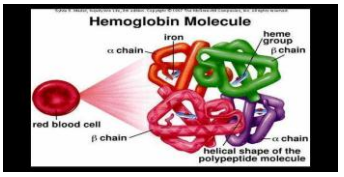
Hemoglobin: Iron/ Protein Compound

- RBC's circulate to body tissues
  - **Oxygen detaches from hemoglobin & diffuses into cells**



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Reticulocyte

- Immature RBC
- Matures within 48 hours & are released
- **Measures the rate in which new RBC's are produced**
- ↑ Retic count = ↑ Need for RBC's

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WBC's Structure & Function

- Primary function: protection from infection
- Appear white when separated from blood
- Two categories of WBC's
  - Granulocytes (3 types)
  - Agranulocytes (2 types)
- All 5 have a different function

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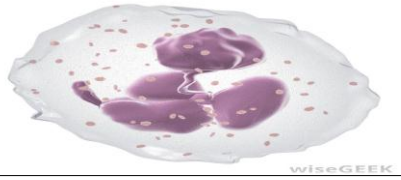
Neutrophil

- Most common type of granulocyte
  - 50-70% of WBC's
- Primarily phagocytic cells
  - Acute inflammatory responses



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Eosinophil

- Granulocyte
- 2 – 4% of WBC's
- Reduced phagocytic action
  - Compared to neutrophils
- Engulf **antigen-antibody responses**
  - ↑ Allergic reactions
  - ↑ Parasitic infections

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Basophil

- Granulocyte
- < 2% of all WBC's
- Contain chemical mediators that are released during allergic or inflammatory responses
  - Histamines

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Lymphocyte

- Agranular
- 20 – 40% of WBC's
- Immune responses
  - Cellular and humoral
    - B cells & T cells
- Circulate the blood and reside in lymphoid tissues

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Monocyte

- Agranular
- 4 – 8% of WBC's
- Potent phagocytic cells
  - Ingest bacteria, dead cells, tissue debris & old dead RBC's
- Present in blood for short time before they migrate to tissues and become macrophages

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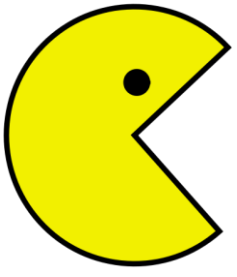
Macrophage = Pac Man



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Macrophage

- Previously Monocytes with ↑ phagocytic capabilities
- Protect the body from pathogens & reside in key areas:
  - Liver: Kupffer cells
  - Bone: Osteoclast macrophages
  - Lung: Alveolar macrophages
- Interact with lymphocytes to facilitate immune responses

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Platelets: Structure & Function

- Function: initiate clotting process by producing plug at site of injury
- Platelets are released into circulation by cells in the bone marrow called **megakaryocytes**
- Lifespan: 8-11 days
- Participate in clot shrinkage and retraction (lysis)

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Thrombopoietin

- Growth factor that acts on bone marrow to stimulate platelet production
- Produced:
  - Liver
  - Kidneys
  - Smooth muscle
  - Bone marrow

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Homeostasis

- Normal blood clotting mechanisms to minimize blood loss after injury

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Four Components of Homeostasis

- Vascular response
- Platelet plug formation
- Development of fibrin clot on platelet plug by plasma clotting factors
- Lysis of clot

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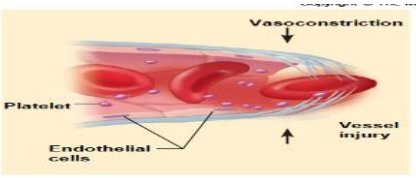
Vascular Response

- Immediate local vasoconstriction



- ↓ Blood leakage from the injured vessels

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Platelet Plug Formation

- Activated by exposure to interstitial collagen from the injured blood vessel (intrinsic)
- Platelet becomes sticky (Adhesiveness)
- Platelet forms clumps (Aggregation)
- Platelets help ↑ reactions of the plasma clotting factors

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Two Clotting Pathways

- Intrinsic Pathway
  - Activated by collagen exposure
    - (substances found in the blood vessels)
- Extrinsic Pathway
  - Initiated when Tissue Factor (TF) or tissue thromboplastin is released from the injured tissues
    - (substances found (external) outside the blood vessels)

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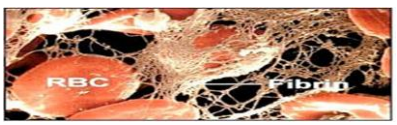
Plasma Clotting Factors

- Form a visible fibrin clot on the platelet plug
- Labeled with Names and Roman Numerals
- Present in inactive forms until stimulated to initiate clotting



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Plasma Clotting Factors (cont)

- Thrombin
  - The most powerful enzyme in the coagulation cascade
  - Converts fibrinogen into fibrin
  - Essential component of a blood clot

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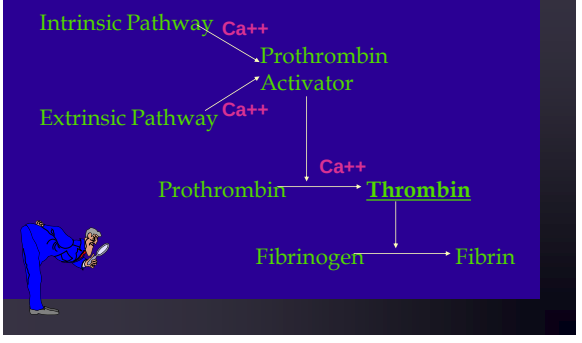
Common Pathway



Video

- Clotting Cascade

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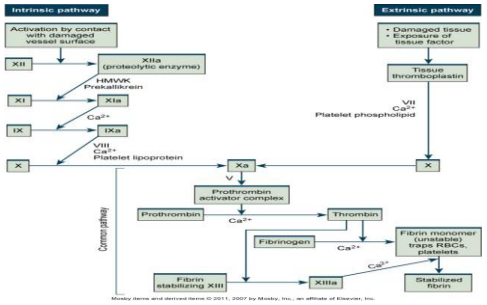
Coagulation Mechanism



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Lysis of Clot: Anticoagulation

- Reverse of clotting
  - Helps keep blood moving
- Anticoagulation occurs by 2 methods
  - Antithrombins: interfere with thrombin
  - Fibrinolysis: process that results in dissolution of the fibrin clot

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Common Anticoagulants

- Lovenox
- Heparin
- * Coumadin: most common oral medication

42 Xarelto Direct Xa inhibitor

Blood Disorders

- Special Considerations
  - Iron Metabolism
    - Hemoglobin (iron-protein combo)
  - Spleen
  - Lymph System

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Iron Metabolism

- Iron is obtained from food or dietary supplements
- Approx: 5-10% is absorbed:
  - Duodenum & upper jejunum
- Approx: 2/3 of total body iron is bound to hemoglobin & myoglobin
- Approx: 1/3 of iron is stored as ferritin
  - Bone marrow, spleen, liver & macrophages

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Iron Metabolism (cont)

- ↓ Stored iron = ↓hemoglobin production
- Transferrin (made in liver): transports iron
- **Iron is recycled** after old & damaged RBC's are phagocytized by liver and spleen macrophages
- **#1 way we loose iron: blood loss**

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- Iron: the originator of recycling: go green

Iron Saturated Transferrin

- Important indicator of available iron supply for developing RBC's

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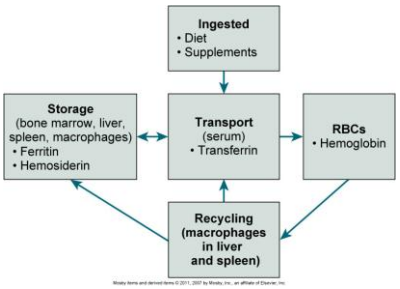
Iron Metabolism



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Spleen: Four Major Functions

- Hematopoietic
- Filtration
- Immunologic
- Storage

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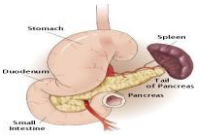
Spleen



- Hematopoietic
  - Produced RBC's during fetal development
- Filtration
  - Removal of old & defective RBC's (MPS system)
  - Removes Hgb from RBC's & returns iron component to the bone marrow for reuse (Part of the recycling process)
  - Filters out bacteria

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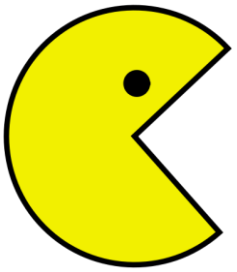
Remember: Pac Man



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Spleen

- Immunologic
  - Contains a rich supply of
    - Lymphocytes
    - Monocytes → macrophages
    - Stored immune globulins
- Storage
  - RBC's
  - Approximately 30% of total mass of platelets

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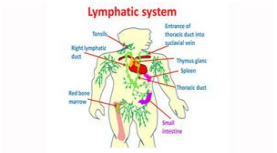
Lymph System



- Primary function:
  - Filtration of pathogens and foreign particles carried by lymph fluid
  - Carries fluid from the interstitial space to the blood

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Liver Function: r/t Hematology

- Functions as a filter
- Produces procoagulants that are essential for hemostasis & blood clotting
- Stores excess iron
- Help regulate iron balance

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Vulnerable patients: Hematological Issues

- Liver
- Renal
- Malnourished
- GI surgery
- Bone marrow suppression: Cancer

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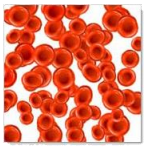
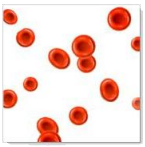
Anemia

- Anemia is a deficiency in the number of erythrocytes (RBC's), the quantity or quality of hemoglobin and or hematocrit
  - (volume of packed RBC's) Lewis pg. 633

Normal amount of red blood cells



Anemic amount of red blood cells



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Anemia

- "Anemia is not a specific disease, it is a manifestation of a pathologic process"
- Anemia: may be a primary problem or can develop as a secondary consequence of the disease
- Identified through H&P
- Classified by Lab review

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Types of Anemia

- Acute Blood Loss (Hemorrhage)
- Chronic Blood Loss
- Iron-Deficiency Anemia
- Anemia of Chronic Disease

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Types of Anemia

- Hemolytic Anemia
- Thalassemia
- Megaloblastic Anemia
  - Cobalamin Deficiency Anemia (B12)
  - Folic Acid Deficiency Anemia
- Aplastic Anemia

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Classifications of Anemia

- Review: CBC, Reticulocyte count, peripheral blood smear
- Types of anemia can be classified by:
  - Morphology (peripheral blood smear)
    - Cellular characteristics
      - What do they look like: Size & Color
  - Etiology
    - Underlying cause

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Anemia: Morphology & Etiology

- Etiology: Acute blood loss/ Hemolysis
  - Normocytic (normal size) & Normochromic (normal color)
- Etiology: Iron-deficient anemia, Vitamin B6 deficiency
  - Microcytic (small size) & Hypochromic (pale)
- Etiology: Vitamin B12 deficiency, Liver disease
  - Macrocytic (large) & Normochromic (normal color)

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See page: 633, Table: 31-1

Severity of Anemia

- **Mild-Hgb 10-12 g/dL**
  - Usually asymptomatic
    - Palpitations, dyspnea & mild fatigue
      - Usually provoked by heavy exercise
    - *Remember if patient has underlying disease process may be symptomatic at this stage

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See page 634, Table 31-3

Severity of Anemia

- **Moderate- Hgb 6-10 g/dL**
  - Cardiopulmonary symptoms increase
    - May experience while at rest
- **Severe- Hgb <6 g/dL**
  - May have multiple signs/symptoms

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See page 634, Table 31-3

To Transfuse or Not to Transfuse: That is the Question?

- **American Association of Blood Banks Guidelines**
  - Hgb <6 – Transfusion recommended
  - Hgb 6-7 – Transfusion likely recommended
  - Hgb 7-8 – Do not transfuse stable patients
- **Consider transfusion only if post-operative or symptomatic** (chest pain, tachycardia unresponsive to fluid resuscitation, or congestive heart failure).
  - Hgb 8 – 10 – TRANSFUSION GENERALLY NOT INDICATED
  - Hgb >10 – TRANSFUSION NOT INDICATED

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Clinical Manifestations: Anemia

- Caused by the body's response to tissue hypoxia
- Depends on the rate and severity in which the anemia has evolved
  - Discuss
    - Trauma victim vs. chronic GI bleed
- Hgb levels are used to determine the severity

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See page 634, Table 31-3

Anemia: Integumentary Changes

- Pallor
  - ↓ Circulating RBC's and Hgb
  - ↓Blood flow to the skin
- Jaundice:
  - Hemolytic anemia = ↑ serum bilirubin
    - Byproduct of RBC destruction
- Pruritus
  - ↑ serum & skin bile salt concentration

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Anemia: Cardiopulmonary Changes

- Attempts by the heart & lungs to provide adequate 02 to the tissues
- Cardiac output maintained by ↑ HR & stroke volume
- *High risk group:
  - Those with existing heart disease

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Anemia: Gerontologic Consideration

- Common in older adult
- Iron deficiency is usually responsible for ↓ hgb levels
  - Chronic disease
  - Nutritional deficiencies

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Anemia: Gerontologic Consideration

- Rule out other causes of bleeding before it is assumed client has iron deficient anemia
  - GI bleed
- S/S may go unrecognized or may be mistaken for normal aging changes

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Anemia: Nursing Diagnosis

- Fatigue
- Altered nutrition: Less then body requirements
- Activity Intolerance: oxygen supply & demand

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Anemia: Nursing Implementation

- Blood transfusions
  - When symptomatic or consider underlying medical diagnosis
- Drug therapy
- Dietary & lifestyle changes
- Oxygen therapy

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Anemia: Patient Teaching

- Goals
  - ADL's (maximize potential)
    - AM ADL's when ↑ energy
- Nutritional intake
- Compliance with medication
- Safety precautions
  - Fall & injury prevention

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Causes of Anemia

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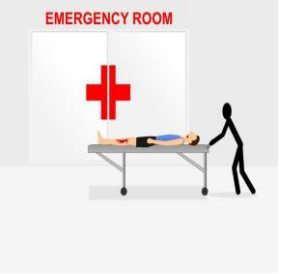
Causes of Anemia: Blood Loss

- Acute Trauma
- Chronic hemorrhage
  - Bleeding ulcer
  - Colorectal cancer
  - Liver disease



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Causes of Anemia: ↓ RBC Production

- ↓ Erythropoietin
- ↓ Nutrients
  - Iron
  - B12, folic acid
- ↓ Iron availability

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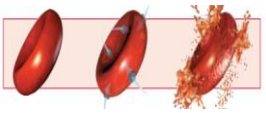
Causes of Anemia: ↑ RBC Destruction



- Hemolysis
  - Sickle cell disease
  - Medications
    - Methyldopa (Aldomet)
  - Incompatible blood
  - Trauma (surgery)

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Case Study

- 32 y/o Hispanic male presented to ER
- VS: B/P 112/72, HR 108, RR 26, T: 99.8
  - C/O bloody diarrhea X 1 year, now 10-12 episodes per day.
  - Hx: ETOH X16 years: 12 pack per day
  - Labs: hgb: 6.2, platelets 694, Iron saturation low, Ferritin low <5ng/mL (iron storage)
  - Transfused 2 units in ER → hgb 7.9
- Admitted to 7C

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Anemia: Acute Blood Loss

- Result from sudden hemorrhage
  - Trauma
  - Complications of surgery

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Acute Blood Loss: Concerns

- Shock is the major complication
  - Hypovolemic shock
- Reduced plasma volume = ↓ circulating 02
  - Cellular death
- Pain
  - Internal hemorrhage: tissue distention, organ displacement, nerve compression, retroperitoneal bleeding

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Acute Blood Loss: Diagnostics

- Labs do not adequately assess RBC problems for 2-3 days
- ER/ICU (not in book)
  - Serial hgb levels
  - Bedside procedure

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Acute Blood Loss: Collaborative Care

- Blood transfusions: prevent shock
- ID source of hemorrhage
- Stop bleeding
  - RB to OR

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Chronic Blood Loss

- Reduced iron stores
  - Considered iron deficient anemia
  - Bleeding ulcer
  - Hemorrhoids
  - Menstrual & postmenopausal blood loss

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Chronic Blood Loss: Management

- Identify source
- Stop bleeding
  - Blood transfusions: prevent shock (if necessary)
- Supplemental iron
  - Dietary may not be adequate to maintain iron stores
    - Oral and or parenteral

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Anemia of Chronic Disease

- Underproduction of RBC's
- Anemia of inflammation
  - Chronic inflammation, autoimmune & infections
- Shortening of RBC survival
  - <120 days

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Anemia of Chronic Disease: Causes

- End-stage renal disease (ESRD)
  - Primary factor: ↓ Erythropoietin
- Chronic liver disease
- Chronic inflammation
- Malignant tumors
- Chronic endocrine disease: hypothyroidism

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Anemia of Chronic Disease: Labs

- ↓ Hgb & Hct
- N or ↑ Serum ferritin stores
  - Distinguish it from iron deficiency anemia
- Normal folate & cobalamin levels
  - Distinguish it from folate or cobalamin deficiencies

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Table 31-6 pg638

Anemia of Chronic Disease: Treatment

- Treat underlying cause
  - Best*
- Rarely blood transfusions
  - Symptomatic
- Erythropoietin therapy
  - Epogen
  - Darbepoetin
    - Use with caution d/t ↑ risk of thromboembolism & death

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Iron Deficiency Anemia

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Iron Deficiency Anemia

Review

- Most common chronic hematologic disorders
- RBC's store iron (heme in hemoglobin)
- Heme accounts for 2/3 of the body's iron

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Iron Deficiency Anemia: Etiology

- #1 Blood Loss
- Inadequate dietary intake
  - 5%-10% of ingested iron is absorbed
- Malabsorption
- Hemolysis

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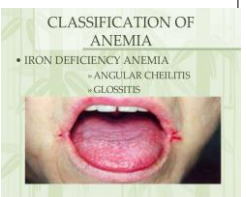
Iron Deficiency Anemia: Clinical Manifestations

- Pallor
  - *Most common

- Glossitis
  - Inflammation of the tongue
    - 2nd most common finding
- Cheilitis
  - Inflammation of the lips



- HA & paresthesia and burning sensation of tongue

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Iron Deficiency Anemia: Diagnostics

- Labs:
  - ↓ Hgb/ Hct
  - ↓ MCV
  - ↓ Serum iron
  - ↓ Ferritin/ (N) or ↓ Transferrin
  - ↑ TIBC (total iron binding **capacity**)
    - Inverse reading: Higher when iron stores are low, and lower when iron stores are high

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Page 638 See table 31-6

Iron Deficiency Anemia: Collaborative Care

- #1 Goal is to treat the underlying cause
- ↑ Iron intake
  - Teach food ↑ in iron
  - Oral or parenteral iron supplement's

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Page 637 See table 31-5

Iron Deficiency Anemia: Drug Therapy

- Oral Iron
  - Best absorbed as ferrous sulfate in an acidic environment
  - Side effects
    - GI upset: Constipation, diarrhea, heartburn, dark stool
      - May need to take with food
        - Vit C or OJ can enhance absorption
  - Liquid iron should be diluted and ingested through a straw

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Iron Deficiency Anemia: Drug Therapy

- Oral Iron
  - Inexpensive
  - Convenient
- Ferrous Sulfate: 300mg or 325mg yields 60mg of elemental iron
  - Ferrous gluconate: substitute

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Iron Deficiency Anemia: At Risk Groups

- Individuals experiencing blood loss
- Postmenopausal women
  - d/t postmenopausal bleeding
- Pregnant women
- Persons from low socioeconomic backgrounds
- Older adults

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Iron Deficiency Anemia: Nursing Management

- Teaching: Diet
  - Liver & muscle meats, eggs, dried fruits, legumes, dark green leafy veggies, whole-grain & enriched breads/ cereals and potatoes (table 31-5)
- Iron supplementation
- Iron therapy for 2-3 months after hgb levels normalize
  - Emphasize compliance

96 Page 637 Table 31-5

Case Study: (cont)

- Rectal Bleed
- Dx: Ulcerative Colitis
  - S/P colonoscopy
  - 8-12 bouts of bloody diarrhea per day
- Meds
  - Ferrous Sulfate 325mg TID
  - IV iron (Sodium Ferric Gluconate Complex)
  - Prednisone
  - Mesalamine PO & PR (tx U.C. ↓ inflammation)
  - *NO NSAIDS

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Blood Disorders

- Part Two
- To be continued ☹

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