

Anemias

Lymphomas & leukemias

Objectives

- Identify types of Anemia
- Identify the causes of Anemia.
- Describe laboratory assessment for diagnosis
- Identify the standards of practice for anemia.

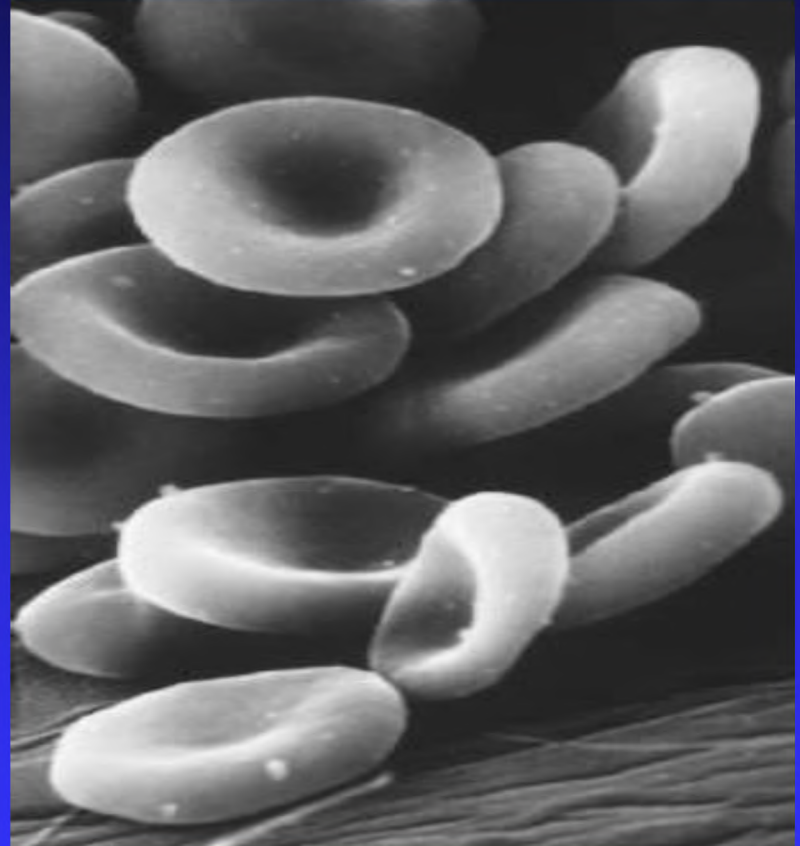
Definition

Anemia:

- A deficiency in the size or number of red blood cells or in the amount of hemoglobin a red blood cell contains
- Decrease in blood hemoglobin below a person's physiological need
- Hemoglobin concentration below 95th percentile of healthy reference population

Causes of Anemia

- Loss of blood (bleeding)
- Loss of blood RBCs (hemolysis)
- Inadequate production of red blood cells (lack of required nutrients, Fe, B12 etc.)
- Inadequate production of red blood cells (chronic diseases, leukemia)



Classifications of Anemia

- Post-hemorrhagic Anemia
- Hemolytic Anemia
- Dyserythropoietic Anemia
- Aplastic Anemia

Symptoms

- Weakness and fatigue
- Pale skin and gums
- Irregular heart beat
- Faintness or dizziness
- Loss of appetite
- Glossitis

How is Anemia Diagnosed?

1. Take a patient history
2. Make visual, auditory, and tactile observations and measurements
3. Formulate list of all possible diagnosis
4. Administer clinical laboratory tests



Assessment

■ Patient history

- ◆ Family history, problems before, changes in physical appearance, changes in energy level

■ Initial Measurements

- ◆ Height /weight comparisons, heart rate, noticeable observations

■ Hematological assessments

- ◆ Urinalysis
- ◆ Laboratory testing

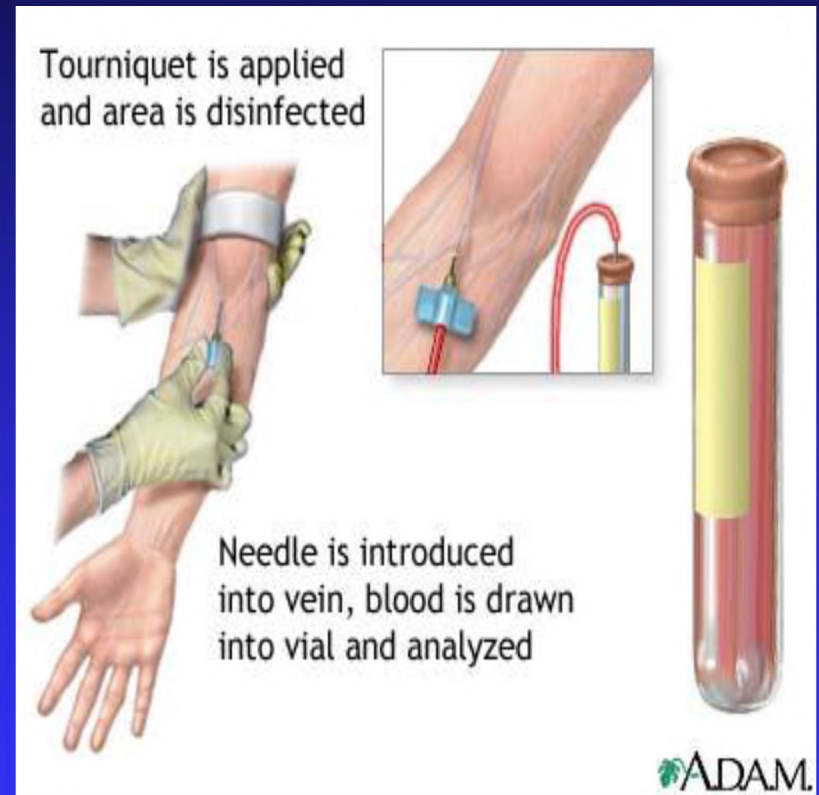
Hematological Assessment

- To detect presence of anemia and type
- To detect associated nutritional deficiencies
- Indicate appropriate nutritional support

Diagnostic Criteria	
Men	RBC < 4.5 million
	Hb < 14 g/ dl
	Packed cell < 42%
Women	RBC < 4 million
	Hb < 12 g/dl
	Packed cell < 37%

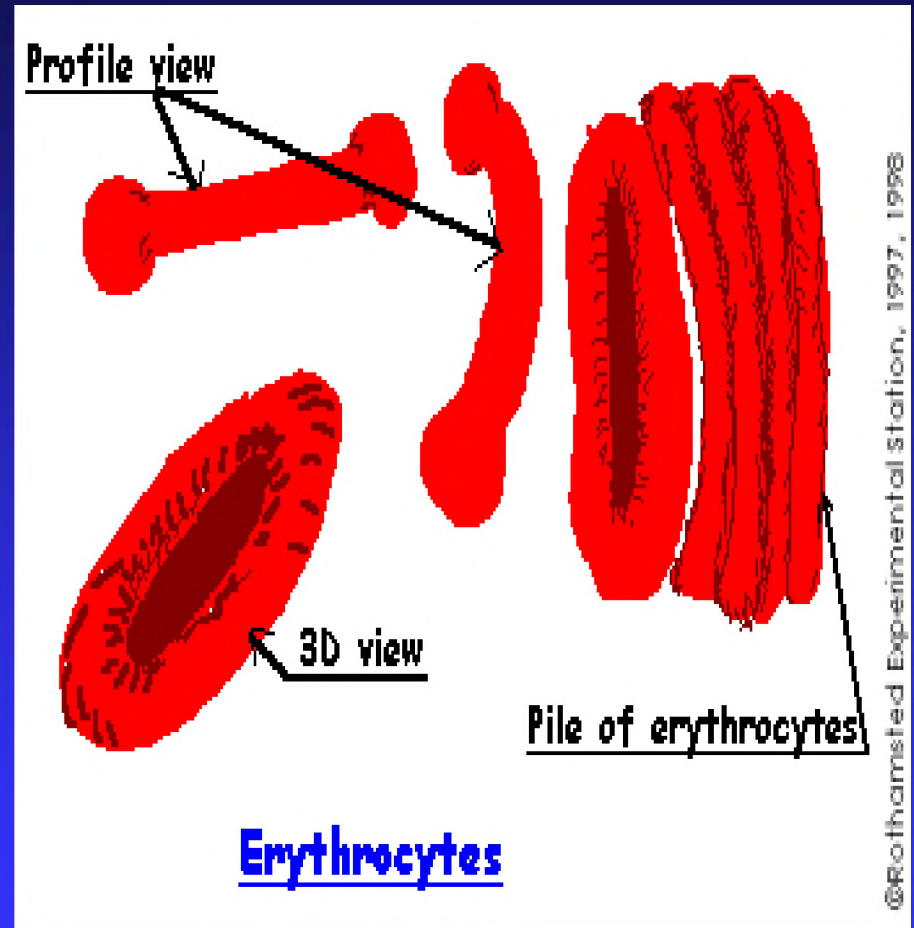
Laboratory Tests

- CBC (complete blood count)
 - ◆ # of red blood cells
 - ◆ Hemoglobin content
 - ◆ Hematocrit- proportion TV that is blood cells
 - ◆ Blood smear- classify size (mcv)
 - ◆ Leukocyte and platelet count
 - ◆ Reticulocyte count

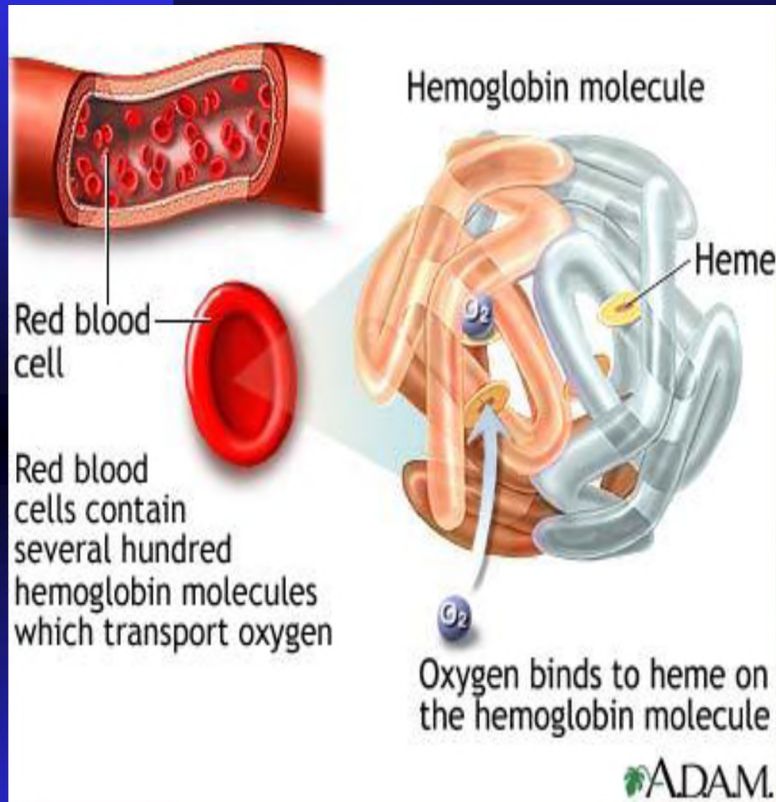


Red Blood Cells

- Deliver oxygen to tissues in the body
- Only live about 120 days
- Also called Erythrocyte
- Normal RBC level
 - ◆ (M): $5.4 \pm .8$ million/ uL
 - ◆ (F): $4.8 \pm .6$ million/ uL



Hemoglobin



■ Normal Hemoglobin

- ◆ Male: 14-18 g/dL
- ◆ Female: 12-16 g/dL

■ Hb content indicated by mean corpuscular hemoglobin (MCH)

$$MCH = Hb \text{ (g/dl} \times 10) / RBC \text{ (millions/mm}^3\text{)}$$

MCH is decreased in microcytic cells

MCH is increased in macrocytic cells

Hematocrit

- The hematocrit is often done by pricking the finger and drawing a drop of blood up into a thin glass tube. Another way is to draw a tube of blood from the arm.
- The RBCs in the sample of blood are packed down by spinning the tube in a centrifuge under prescribed conditions. The proportion of the tube that consists of RBCs is then measured. Let's say that it is 45%. The hematocrit is 45.

Blood Smear

- Under a microscope can classify cells
 - ◆ Small (microcytic)
 - ◆ Normal (normocytic)
 - ◆ Large (macrocytic)
- Size related to Mean Corpuscular Volume
$$\text{MCV} = \text{Hct} \times 10 / \text{RBC (millions/ mm}^3\text{)}$$
 - ◆ MCV is decreased in Microcytic Anemia
 - ◆ MCV is increased in Macrocytic Anemia



Leukocyte and platelet count

■ Leukocyte

- ◆ Low count: indicates marrow failure
- ◆ High count: indicates anemia caused by leukemia or infection

■ Reticulocyte - large, nucleated, immature red blood cells

- ◆ High count: indicates a response to bleeding

Other Laboratory Tests

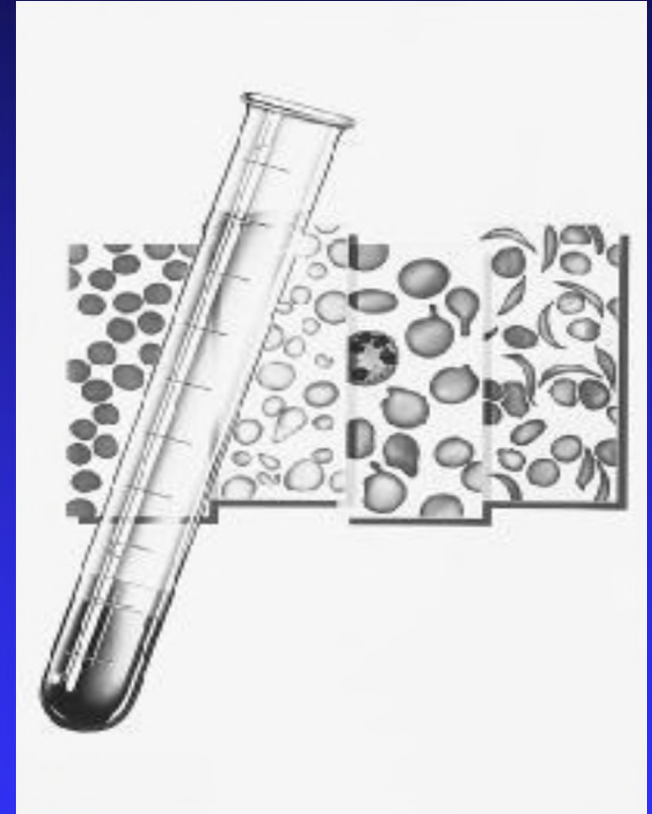
- The patient is placed in a category based upon the diagnosis from the CBC
 - ◆ further testing is needed to confirm diagnosis.
- Microcytic Anemia
 - ◆ Serum iron, total iron binding capacity, serum ferritin are measured
- Macrocytic Anemia
 - ◆ Tests for foliate and vit. B₁₂ are taken
 - ◆ Homocysteine levels are measured

General Treatment for Anemia

1. Diet
2. Nutritional Supplements:
E.g.) Iron, B₁₂, folic acid
3. Treatment of infection or inflammation
4. Erythropoietin- drug to treat low blood cell count (mainly used with renal patients)
5. Blood transfusion
6. Bone Marrow Transplant

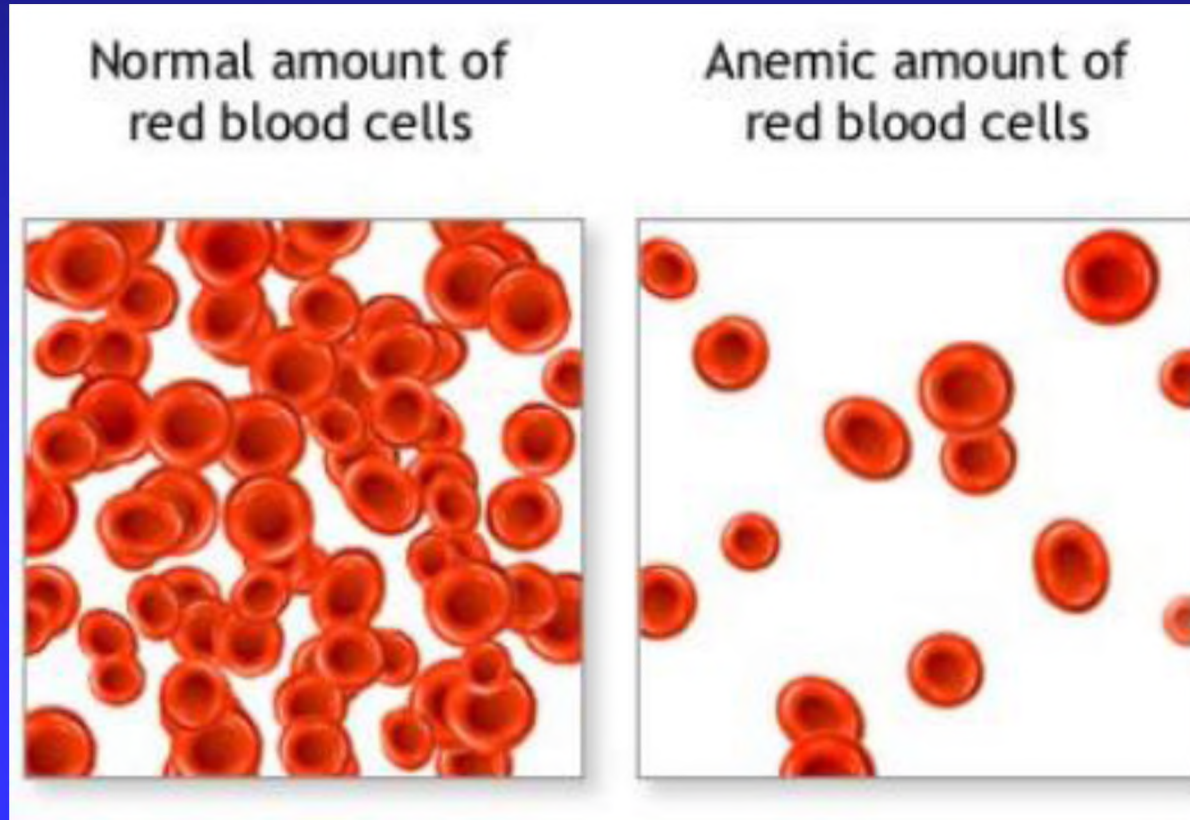
Classifications of Anemia

- Microcytic- RBC volume < 80 fl oz. (small RBC's)
D < 6 mcm
- Normocytic- RBC volume 80-99 fl oz. (normal RBC's)
- Macrocytic- Blood volume < 100 fl oz. (Large RBC's)
D > 9 mcm



Post-hemorrhagic Anemia

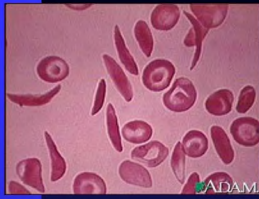
- Loss of blood
- Acute and Chronic





Hemolytic Anemia

- Cause: abnormally shortened red cell life span due to disease in the small blood vessel
 - ◆ Marrow is normal but RBC die faster than marrow can replace it.
- Treatment: Depends on the underlined cause



Inherited Anemia

■ Sickle Cell Anemia

- ◆ Considered a “black” disease but has been detected in white populations
- ◆ Cause: Results in defective hemoglobin synthesis, produces sickle shaped red blood cells
 - ◆ Get caught in capillaries and don’t carry oxygen well, similar to having mini heart attacks
 - ◆ Leads to blindness, leg ulcers, stroke, etc.
- ◆ New Hope: A NHLBI study involving 299 patients having painful crisis's associated with sickle cell anemia found that those patients receiving Hydrea (a drug thought to increase levels of hemoglobin in RBC) had half as many painful bouts as those given the placebo. (Mayfield, 1996)

Dyserythropoietic Anemia

- ◆ Pernicious (macrocytic)
- ◆ Folic Acid Deficiency (macrocytic)
- ◆ Refractory Anemia

Pernicious Anemia

- Recommended Dietary Allowances (RDA) : 3 micrograms/day
- Cause: Inability to absorb vitamin B12
 - ◆ B12 attaches itself to intrinsic factor in order to be absorbed.
 - ◆ Parietal cells shrink so parietal cells can't produce intrinsic factor
- At Risk: people over 60, African Americans, Northern Europeans, strict vegetarians
- Diagnosis: Schilling test- given radioactive B12 alone and then attached to intrinsic factor
- Treatment: Foods with B12 – meat, dairy, etc.
Lifelong injection B12 directly into bloodstream so don't need intrinsic factor.

Folic Acid Deficiency Anemia

- RDA: 400 mg/ day
 - ◆ Requirements double during pregnancy
- Cause: Inadequate absorption, increased excretion, increased requirement, destruction of folic acid.
 - ◆ Folic acid and B-12 have interrelated role in synthesis of DNA
- At risk: Pregnant women, alcoholics, low economic status, women over 30, infants born to folic acid deficient mothers



Folic Acid Deficiency

- Sources: leafy green vegetables, oatmeal, peanut butter
 - ◆ folate easily destroyed by sunlight, overcooking, storing for extended periods
- Treatment: increase foods high in folic acid, folic acid supplement, avoid alcohol and tobacco

Refractory Anemia

- Cause: Damage to DNA of blood cells in the bone marrow. The marrow fills up with blood cell precursors but can't get out into blood stream
- At risk: Elderly
- Diagnosis: Low counts of reticulocytes, white blood cells, platelets, but have normal serum B12 and folic acid levels.
- Treatment:
 - ◆ Blood transfusion- after while antibodies form
 - ◆ Bone marrow transplant- Advanced age of most people makes it feasible less than 10% of time
 - ◆ Survival time : 2.5 years
 - ◆ Cause of death usually infection

Microcytic Anemias

- Iron Deficiency Anemia
 - ◆ Sports Anemia
 - ◆ Maternal Anemia
- Copper Deficiency Anemia
- Thalassemia

Iron Deficiency

- Most common type of deficiency
- Cause: Lack of iron in bone marrow
- At Risk: Some are more at risk than others
 - ◆ Vegetarians
 - ◆ Infants
 - ◆ Pregnant women
 - ◆ Menstruating women
 - ◆ People with excessive blood loss
 - ◆ People with chronic disorders
 - ◆ Endurance athletes

Iron Absorption

Increase absorption:

Vitamin C

Vitamin B6

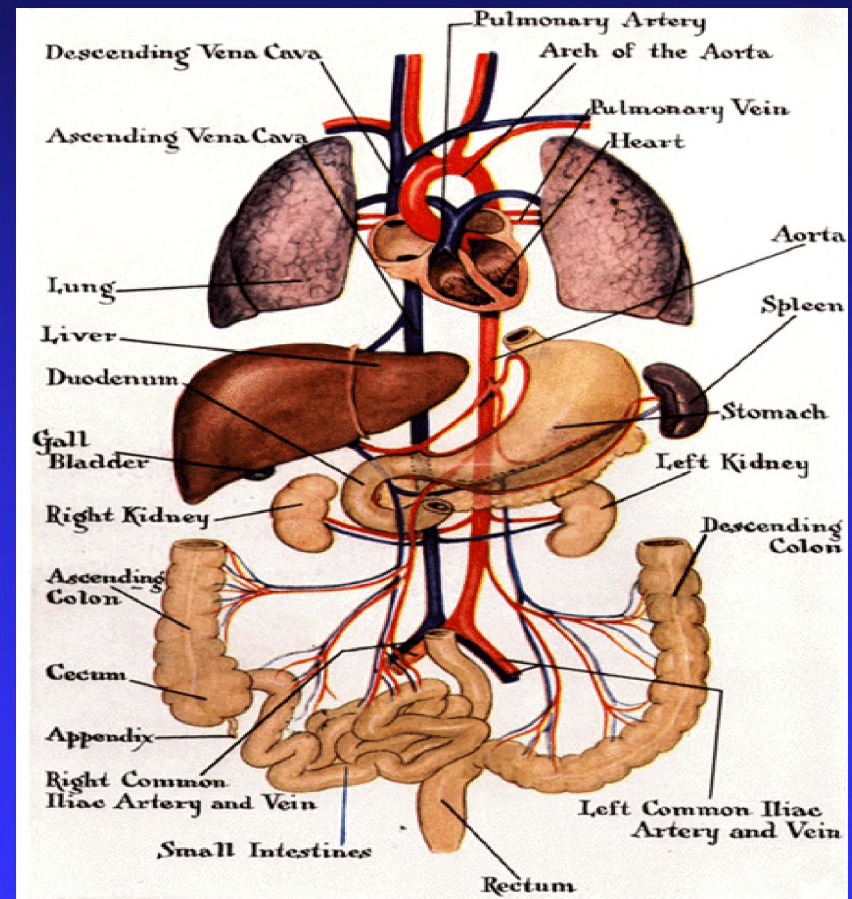
Iron Stores are low

Limit Absorption:

Phosphates- fiber rich food

High amounts of Cu

- Stomach- facilitates absorption by secreting gastric acid
- Duodenum - where iron absorbed



Intake of Iron

Recommended Intake:

	<u>Age</u>	<u>Intake</u>		<u>Age</u>	<u>Intake</u>
Female	4-8	10 mg	Male	4-8	10 mg
	9-13	8 mg		9-13	8 mg
	14-18	15 mg		14-18	11 mg
	19-50	18 mg		19-up	8 mg
	51- up	8 mg			

Sources of Iron:

Beef, chicken, fortified breakfast cereal, beans, whole wheat grains, spinach, ect.

Sports Anemia

- **At risk:** females, vegetarians, endurance athletes, still growing
- **Treatment:** eat iron rich foods that contain protein, avoid foods that inhibit absorption



Maternal Anemia



- **Maternal Anemia-** hematocrit less than 32% and hemoglobin less than 11 g/dl
- Increased blood volume leads to increased demand for iron
- Usually comes about at the end of pregnancy
- During pregnancy must have 27 mg/ day
- Rarely have sufficient iron stores so often a supplement of ferrous salt is recommended (200mg in 3-4 doses/ day).

Maternal Anemia Studies

- there is an association between low maternal hemoglobin concentration and poor pregnancy outcomes. The risk of preterm delivery was doubled.
- Severe maternal anemia ($<8\text{g/dl}$) is associated with birth weight values that are 200-400 g than women who have normal hemoglobin values

Copper Deficiency

- Copper: essential for life, required for normal infant development, red and white blood cell maturation, and iron transport.
 - ◆ Absorbed by stomach and small intestine
 - ◆ Absorption decreased by excess dietary iron and zinc
- RDA: 1.5- 3 mg/day
- Cu Deficiency: symptoms similar to iron deficiency
 - ◆ Increases vulnerability to infections
 - ◆ Kinky hair disease

Copper Deficiency Research

- Anemia's role in myocardial hypertrophy:

Anemia with copper deficiency contributes to heart pathology. Researchers found that RBC administered to copper deficient rats fed fructose prevented anemia and heart hypertrophy. The control group, also copper deficient was fed fructose but wasn't given RBC. The control group became anemic and had indications of heart hypertrophy. (Fields et al ,1991)

- Copper deficient rats and membrane fluidity:

Rock et al (1995) examined the relationship between copper deficiency and shorter survival of red blood cells. Fluorescence polarization studies show an increase in fluidity in RBC membrane of Copper deficient rats. This suggests that these RBC are more vulnerable to hydrolysis and therefore have shorter survival time.



Thalassemia



- Severe inherited anemia affecting primarily people in Mediterranean region
- Microcytic and short lived RBC result from defective hemoglobin synthesis
- Characterized by excessive amounts of iron absorption that accumulates in the body and leads to dysfunction of heart, liver and endocrine glands
- Need transfusion to stay alive

Aplastic Anemia

- Cause: The basic structure of the marrow becomes abnormal and causes the hematopoietic cells that make blood cells to die off, these cells are often replaced by fat.
 - ◆ Associated with exposure to drugs (anti-cancer), radiation, chemicals, pregnancy
- At risk: Asian decent, young adults (15-30), and elderly
- Diagnosis: Blood count low for all formed blood cells, hematopoietic cells replaced with fat
- Treatment:
 - blood transfusion- temporary help
 - Bone marrow transplant- bone marrow must be compatible with immune system (60-80% success)

Anemia of Chronic Disease

- 2nd most common type of anemia
- Cause: Associated with general systemic illnesses that are characterized by inflammation
 - ◆ Lupus, rheumatoid arthritis, cancer, etc.
- Diagnosis: No diagnostic tests- diagnosis made after all other forms of anemia have been ruled out

Normacytic Anemia

- Aplastic
- Anemia of Chronic Disease
- Inherited Anemia
- Hemolytic Anemia