

PATHOLOGY OF BLOOD AND LYMPHATIC SYSTEM

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ANEMIA



DEFINITION

- ☐ Reduction of oxygen carrying capacity of blood secondary to decrease in red cell mass
- ☐ Leads to tissue hypoxia
- ☐ Practically, measure by Hemoglobin concentration, and Hematocrit

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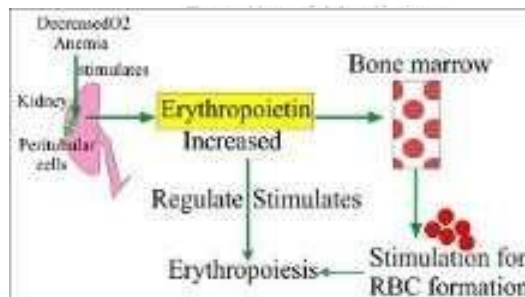


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ANEMIA AND ERYTHROPOIETIN

- ❑ Anemia triggers production of erythropoietin
- ❑ Causes compensatory erythroid hyperplasia in bone marrow (BM)
- ❑ In acute anemia, production can increase by 5x or more in healthy people
- ❑ In severe cases, causes extramedullary hematopoiesis in secondary hematopoietic organs (spleen, liver and lymph nodes)
- ❑ Exceptions: anemia of renal failure, anemia of chronic inflammation



CLASSIFICATION ACCORDING TO CAUSE

1) Blood loss

2) Diminished RBC production

- Iron deficiency anemia
- Anemia of chronic inflammation
- Megaloblastic anemia
- Aplastic anemia
- Pure red cell aplasia
- Myelophthisic anemia
- Myelodysplastic syndrome
- Anemia of renal failure
- Anemia of hypothyroidism

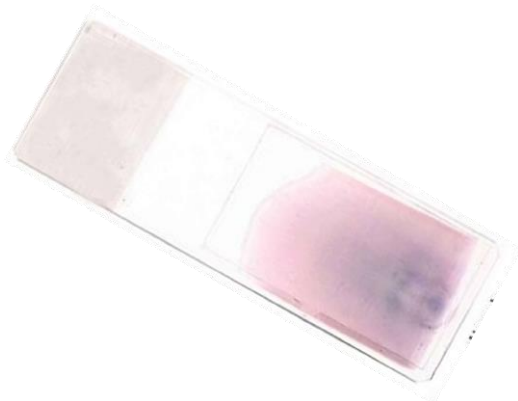
3) Increased destruction (hemolytic anemia)

- ☐ Extrinsic factors (infection, antibody, mechanical)
- ☐ Intrinsic RBC abnormalities:
 - 1) Hereditary (membrane, enzyme, Hg abnormalities)
 - 2) Acquired (Paroxysmal nocturnal hematuria)



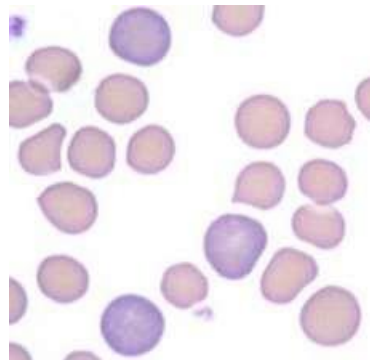
CLASSIFICATION ACCORDING TO MORPHOLOGY BLOOD FILM

- Size: normo, micro, macrocytic (MCV)
- Color: normo, hypochromic (MCH)
- Shape: anisopoikilocytosis (spherocytes, sickle, schistocytes) (RBC distribution width)
- Hypochromic microcytic anemia usually reflects impaired Hg synthesis
- Macrocytic anemia reflects stem cell disease and maturation



RBC INDICES

- Can be directly measured, or automated
- Slight variation is present between labs, geographic areas
- Sex, age, race, mobility status have effect
- Reticulocyte count: helps differentiate hemolytic anemia (high) from regenerative anemia (low)



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	Units	Men	Women
Hemoglobin (Hb)	g/dL	13.2–16.7	11.9–15.0
Hematocrit (Hct)	%	38–48	35–44
Red cell count	$\times 10^6/\mu\text{L}$	4.2–5.6	3.8–5.0
Reticulocyte count	%	0.5–1.5	0.5–1.5
Mean cell volume (MCV)	fL	81–97	81–97
Mean cell Hb (MCH)	pg	28–34	28–34
Mean cell Hb concentration (MCHC)	g/dL	33–35	33–35
Red cell distribution width (RDW)		11.5–14.8	

*Reference ranges vary among laboratories. The reference ranges for the laboratory providing the result should always be used in interpreting a laboratory test.



CLINICAL FEATURES OF ANEMIA

- ☐ Dizziness (hypotension)
- ☐ Fatigue
- ☐ Pallor
- ☐ Headache

Adaptive changes:

- ☐ Tachycardia
- ☐ Tachypnea
- ☐ Increased redcell 2,3-diphosphoglycerate

If the patient has heart or lung diseases, symptoms will be worse

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CLINICAL SYMPTOMS IN SPECIAL TYPES OF ANEMIA

- Chronic hemolytic anemia: jaundice, pigmented gall bladder stones, red urine

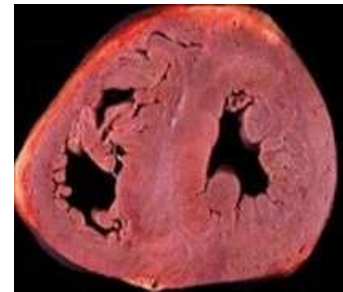
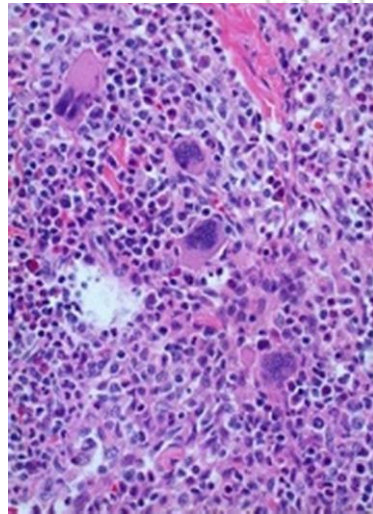


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CLINICAL SYMPTOMS IN SPECIAL TYPES OF ANEMIA

- Extramedullary hematopoiesis: splenomegaly, hepatomegaly
- Thalassemia major and sickle cell anemia: growth retardation, bone deformity, secondary hemochromatosis (damage to heart, endocrine glands)



ANEMIA OF ACUTE BLOOD LOSS

- ☐ Symptoms are related to decreased intravascular volume,
- ☐ If loss is $> 20\%$ of blood volume, patient might have hypovolemic shock and death
- ☐ Body responds by shifting fluid from interstitial to intravascular space, causing dilutional anemia and worse hypoxia (stays 2-3 days)
- ☐ Erythropoietin secretion is stimulated, activating BM erythropoiesis (needs 5-7 days)
- ☐ In internal hemorrhage, iron is restored from extravasated RBCs and used again in erythropoiesis
- ☐ In external and GIT hemorrhage, iron is lost, which complicates anemia
- ☐ The anemia is normochromic normocytic, with reticulocytosis



ANEMIA OF CHRONIC BLOOD LOSS

- ❑ Occurs when the rate of RBC loss exceeds regeneration
- ❑ Mostly occurs in gastrointestinal diseases, also in excessive menstruation
- ❑ Results in iron deficiency, anemia appears hypochromic and microcytic, low reticulocytes



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