Anemia: Classification, Signs and Symptoms, Treatment

Anemia is defined as a **decrease in red blood cell (RBC) mass** , hemoglobin (Hb), and/or hematocrit (Hct) **below the reference range** for age and sex. It reflects a reduced **oxygen-carrying capacity** of the blood.

Normal Reference Ranges:

Parameter	Male	Female
RBC count	4.5–5.9 x10?/µL	4.1–5.1 x10?/µL
Hemoglobin	14.0–17.5 g/dL	12.3–15.3 g/dL
Hematocrit	43–50%	36–45%

Types of Anemia

I. Etiologic Classification

Etiology	Mechanism
Impaired RBC production	Bone marrow failure, nutrient deficiency, chronic disease
Increased RBC destruction (hemolysis)	Inherited or acquired defects
Blood loss	Acute (e.g., trauma) or chronic (e.g., GI bleeding, menstruation)

II. Morphologic Classification

Based on **Mean Corpuscular Volume (MCV)** and **Mean Corpuscular Hemoglobin Concentration (MCHC)** :

Morphology	MCV	MCHC	Examples
Macrocytic	> 94 fL	> 31%	Vitamin B12 & folate deficiency, myelodysplastic syndromes
Microcytic hypochromic	< 80 fL	< 27%	Iron deficiency, thalassemia
Normocytic normochromic	82–92 fL	> 30%	Aplastic anemia, hemolysis, chronic disease

Etiologies in Detail

A. Impaired RBC Production

1. **Bone Marrow Failure**
    - *Aplastic anemia*
    - *Myelophthisis* (bone marrow infiltration by fibrosis, leukemia)
2. **Deficiencies of Essential Factors**
    - Iron deficiency anemia
    - Vitamin B12 deficiency (pernicious anemia)
    - Folate deficiency
    - Anemia in **chronic kidney disease** (? erythropoietin)
3. **Reduced Hormonal Stimulation**
    - Hypothyroidism
    - Hypopituitarism
    - Anemia of chronic inflammation (e.g., autoimmune disease, malignancy)

B. Excessive RBC Destruction (Hemolytic Anemias)

1. Intracorpuscular Defects (inherited):

- Membrane defects: *Hereditary spherocytosis, elliptocytosis*
- Enzyme defects: *G6PD deficiency*
- Hemoglobinopathies: *Thalassemia, sickle cell disease*

2. Extracorpuscular Defects (acquired):

- **Mechanical** : MAHA (e.g., DIC, TTP, prosthetic valves)
- **Infectious** : Malaria, Clostridium perfringens
- **Autoimmune** : SLE, transfusion reactions
- **Hypersplenism**

C. Blood Loss

- **Acute** : Trauma, GI hemorrhage
- **Chronic** : Menorrhagia, hookworm infestation, GI ulcers

True vs. Pseudo-Anemia

Type	Description	Example
True anemia	? RBC mass with normal plasma volume	Nutritional deficiency, hemolysis
Pseudo-anemia	Normal RBC mass, ? plasma volume (dilutional)	Pregnancy, IV fluid overload, CHF

Clinical Features of Anemia

Symptoms:

- Fatigue
- Dyspnea on exertion
- Lightheadedness
- Chest pain or worsening angina

Signs:

- Pallor (especially mucous membranes)
- Tachycardia
- Systolic flow murmur
- Orthostatic hypotension
- Ankle edema (in severe cases)
- Tachypnea
- Raised JVP

Workup and Diagnosis

Initial Labs:

- CBC (RBC count, Hgb, Hct, MCV, MCHC)
- Reticulocyte count
- Peripheral blood smear
- Iron studies (serum ferritin, TIBC, transferrin saturation)
- Vitamin B12 and folate levels
- LDH, haptoglobin, bilirubin (for hemolysis)
- Coombs test (if autoimmune hemolysis suspected)

Treatment Principles

Always treat the underlying cause first.

1. Iron Deficiency Anemia

- **Oral iron** : Ferrous sulfate 325 mg once daily on an empty stomach
- Parenteral iron if oral is not tolerated or ineffective
- Address source of bleeding (e.g., GI lesions, heavy menstruation)

2. Vitamin B12 Deficiency

- IM or SC **Vitamin B12** 100 mcg injections weekly until corrected, then monthly

3. Folate Deficiency

- Oral folic acid 1 mg/day

4. Anemia of Chronic Disease

- Treat the underlying condition
- Consider **erythropoiesis-stimulating agents (ESA)** if anemia is symptomatic or severe (e.g., in CKD)

5. Hemolytic Anemia

- Manage triggers (e.g., avoid oxidant drugs in G6PD deficiency)
- Immunosuppressants or transfusion in autoimmune hemolysis
- Splenectomy in hereditary spherocytosis (if severe)

6. Severe or Symptomatic Anemia

- **RBC transfusion** if Hgb < 7–8 g/dL or symptomatic
- Consider ESA if transfusion is contraindicated or ineffective

High-Yield Pearls

- **MCV < 80** = Microcytic ? Think Iron Deficiency, Thalassemia
- **MCV > 100** = Macrocytic ? Think B12/Folate deficiency, drugs
- **High Retic Count** = Bone marrow is responding (think hemolysis or bleeding)
- **Low Retic Count** = Bone marrow failure or nutrient deficiency
- **TIBC ? + Ferritin ? = Iron Deficiency Anemia**
- **Ferritin ? + TIBC ? = Anemia of Chronic Disease**