Ministry of Higher Education

**And Scientific Research**

**Al-Rasheed University College**

**Department of medical laboratory techniques**

# Anemia/ definition

Class: 3’d stage Lecture (4)

**Subject: Hematology.**

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* Anemia and sometimes called erythrocytopenia, is a decrease in the total amount of red blood cells (RBCs) or hemoglobin in the blood or a lowered ability of the blood to carry oxygen. A broader definition is a lowered ability of the blood to carry oxygen.

# Definitions

There are a number of definitions of anemia; reviews provide comparison and contrast of them. A strict but broad definition is an absolute decrease in red blood cell mass, however, a broader definition is a lowered ability of the blood to carry oxygen. An operational definition is a decrease in whole- blood hemoglobin concentration of more than 2 standard deviations below the mean of an age- and sex-matched reference range.

# Classification

Anemia can also be classified based on: 1. the size of the red blood cells

and **2. Amount of hemoglobin in each cell.** If the cells are small, it is called **microcytic anemia;** if they are large, it is called **macrocytic anemia;** and if they are normal sized, it is called **normocytic anemia.**

# Causes

The causes of anemia may be **classified** as 1.impaired red blood cell (RBC) production.

1. increased RBC destruction (hemolytic anemias).
2. Blood loss.
3. Fluid overload (hypervolemia).

Several of these may interplay to cause anemia. The most common cause of anemia is blood loss, but this usually does not cause any lasting symptoms unless a relatively impaired RBC production develops, in turn, most commonly by iron deficiency.

## Impaired production

* + **Disturbance of proliferation and differentiation of stem cells**
    - Pure red cell aplasia.

Aplastic anemia affects all kinds of blood cells. Fanconi anemia is a hereditary disorder or defect featuring aplastic anemia and various other abnormalities.

* + - Anemia of kidney failure due to insufficient production of the hormone erythropoietin.

Anemia of endocrine disease.

## Disturbance of proliferation and maturation of erythroblasts

Pernicious anemia is a form of megaloblastic anemia due to vitamin Bi2deficiency dependent on impaired absorption of vitamin B i2. Lack of dietary Bi2causes non-pernicious megaloblastic anemia.

* + - Anemia of folate deficiency, as with vitamin Bi2, causes megaloblastic anemia.
    - Anemia of prematurity, by diminished erythropoietin response to declining hematocrit levels, combined with blood loss from laboratory testing, generally occurs in premature infants at two to six weeks of age.

Iron deficiency anemia, resulting in deficient heme synthesis. Thalassemias, causing deficient globin synthesis.

* + - Congenital dyserythropoietic anemias, causing ineffective erythropoiesis.

Anemia of kidney failure (also causing stem cell dysfunction)

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## Other mechanisms of impaired RBC production

Myelophthisic anemia or myelophthisis is a severe type of anemia resulting from the replacement of bone marrow by other materials, such as malignant tumors, fibrosis, or granulomas.

Myelodysplastic syndrome.

* + - anemia of chronic inflammation.

Leukoerythroblastic anemia is caused by space-occupying lesions in the bone marrow that prevent normal production of blood cells.

## Increased destruction

Anemias of increased red blood cell destruction are generally classified as hemolytic anemias. These are generally featuring jaundice and elevated lactate dehydrogenase levels.

* + Intrinsic (intracorpuscular) abnormalities cause premature destruction. All of these, except paroxysmal nocturnal hemoglobinuria, are hereditary genetic disorders.

Hereditary spherocytosis is a hereditary defect that results in defects in the RBC cell membrane, causing the erythrocytes to be sequestered and destroyed by the spleen.

Hereditary elliptocytosis is another defect in membrane skeleton proteins.

* + - Abetalipoproteinemia, causing defects in membrane lipids Enzyme deficiencies:
      * Pyruvate kinase and hexokinase deficiencies, causing defect glycolysis
      * Glucose-6-phosphate dehydrogenase deficiency and glutathione synthetase deficiency, causing increased oxidative stress

Hemoglobinopathies

* + - * Sickle cell anemia.
      * Hemoglobinopathies causing unstable hemoglobins.

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* + - Paroxysmal nocturnal hemoglobinuria

## Extrinsic (extracorpuscular) abnormalities

Antibody-mediated

* Warm autoimmune hemolytic anemia is caused by autoimmune attack against red blood cells, primarily by IgG. It is the most common of the autoimmune hemolytic diseases. It can be idiopathic, that is, without any known cause, drug-associated or secondary to another disease such as systemic lupus erythematosus, or a malignancy, such as chronic lymphocytic leukemia.
* Cold agglutinin hemolytic anemia is primarily mediated by IgM. It can be idiopathic[31 or result from an underlying condition.
* Rh disease,[23 one of the causes of hemolytic disease of the newborn
* Transfusion reaction to blood transfusions.
  + - Mechanical trauma to red blood cells
      * Microangiopathic hemolytic anemias, including thrombotic thrombocytopenic purpura and disseminated intravascular coagulation.
      * Infections, including malaria[23]
      * Heart surgery.
      * Haemodialysis.

## Blood loss

* + Anemia of prematurity, from frequent blood sampling for laboratory testing, combined with insufficient RBC production
  + Traumaor surgery, causing acute blood loss
  + Gastrointestinal tract lesions, causing either acute bleeds (e.g. variceal lesions, peptic ulcers) or chronic blood loss (e.g. angiodysplasia)
  + Gynecologic disturbances, also generally causing chronic blood loss.

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* + From menstruation, mostly among young women or older women who have fibroids
  + Many type of cancers, including colorectal cancer and cancer of the urinary bladder, may cause acute or chronic blood loss, especially at advanced stages
  + Infection by intestinal nematodes feeding on blood, such as hookworms and the whipworm *Trichuris trichfura.*
  + latrogenic anemia, blood loss from repeated blood draws and medical procedures.

## Fluid overload

Fluid overload (hypervolemia) causes decreased hemoglobin concentration and apparent anemia:

* + General causes of hypervolemia include excessive sodium or fluid intake, sodium or water retention and fluid shift into the intravascular space.
* From the 6th week of pregnancy, hormonal changes cause an increase in the mother's blood volume due to an increase in plasma.

## Intestinal inflammation

* Certain gastrointestinal disorders can cause anemia. The mechanisms involved are multifactorial and not limited to malabsorption but mainly related to chronic intestinal inflammation, which causes dysregulation of hepcidin that leads to decreased access of iron to the circulation.
  + *Helicobacter pylori* infection.
  + Gluten-related disorders: untreated celiac disease and non-celiac gluten sensitivity. Anemia can be the only manifestation of celiac disease, in absence of gastrointestinal or any other symptoms.
  + Inflammatory bowel disease.

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