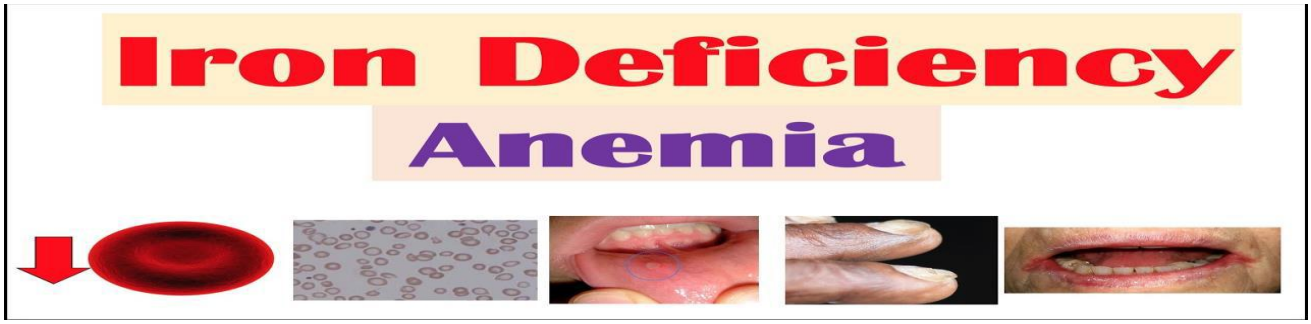
Lec5: Iron deficiency anemia(IDA)

- It is most common throughout the world, affecting 25% of the world population
- It is hypochromic microcytic type anemia,
- It was occurring when the imbalance of iron intake, iron stores, and the body's loss of iron are insufficient to fully support production of erythrocytes. IDA rarely causes death, but the impact on human health is significant.



Iron forms in human body : The two most common iron states are the divalent ferrous (Fe2+) and the trivalent ferric (Fe3+). Within the human body, iron is required as a cofactor for many hemoproteins and non-hemoproteins.

- Hemoproteins include hemoglobin and myoglobin that are responsible for oxygen binding and transport, catalase and peroxidase enzymes, which take part in oxygen metabolism, and cytochromes, that important in electron transport and mitochondrial respiration.
- Non-hemoproteins also have used in DNA synthesis, cell proliferation, gene regulation, drug metabolism, and steroid synthesis
- The normal total amount of iron in human has 70 kg, about 3500–4000 mg, corresponding to an average concentration of 50–60 mg of iron per kg of body weight.

Iron storage

1. The vast majority (65% to 70 %) of iron in the body is found in erythrocytes.
2. 10 % in the myoglobin of muscle and iron containing enzymes and proteins .
3. 20% to 25 % in iron storage pool

A. Female (50 mg/kg body weight) (2 to 3 gram of iron in body)
B. Male (60 mg/kg body weight) (about 4 gram of iron in body)

4.Bound to heme

A. 1 mg of iron needed for 1 ml of RBCs
B. 20 to 25 mg of iron needed for daily erythropoiesis

Iron Hemostasis and Metabolism:

Two main sources of iron Fe++ in the body, 1-dietry 2-recycled iron from RBC degradation.

Iron metabolism steps:

1. Small intestine duodenum cells (enterocytes) absorbed iron Fe++ from food digestion.
2. Upon absorption, iron circulates around the body bound to the protein transferrin (A plasma protein that transports iron through the blood to the liver, spleen and bone marrow) and is taken up by tissues for utilization such as erythropoiesis in bone marrow, myoglobin synthesis in muscle, and oxidative metabolism in all respiring cells.
3. The reticuloendothelial system (RES), which includes macrophages, recycles iron from senescent erythrocytes.
4. The liver produces the hormone Hepcidin that controls the release of iron from enterocytes and macrophages into the circulation and is regarded as the master regulator of systemic iron metabolism.
5. Iron enter to the cells by special receptors for transferrin (TFR1, TFR2), in the cytoplasm, ferrous iron is found in a soluble, it can be stored in Ferritin (protein storage 4500 iron molecule as ferric iron Fe+++) in liver and bone marrow, due to the ferroxidase (which converted Fe++ to Fe+++). If the capacity for storage of iron in ferritin is exceeded, a complex of iron with phosphate and hydroxide forms dysfunctional ferritin as Hemosiderin (which form after bleeding, when macrophage engulfed hemoglobin of destroyed RBC).

Common signs and symptoms of IDA are:

1-Difficulties with memory and concentration 2-Fatigue 3- Dizziness 4-Feeling unusually cold 5-Pale skin 6-Chest pain 7-fast heartbeat or shortness of breath 8-Headache 9-Poor appetite, especially in infants and children 10- Brittle nails.

Causes of iron deficiency:

1. Blood loss like in menstruation, gastrointestinal bleeding especially by use aspirin

2. A lack of iron in your diet. Body regularly gets iron from the foods you eat. Examples of iron-rich foods include meat, eggs, leafy green vegetables and iron-fortified foods. The normal requirements of iron 8 mg per day for men, 18 mg per day for premenopausal women. 8 mg a day for postmenopausal women.
3. An inability to absorb iron. An intestinal disorder, such as celiac disease, which affects your intestine's ability to absorb nutrients from digested food, can lead to iron deficiency anemia. Also If part of small intestine has been bypassed or removed surgically,
4. Pregnancy. without iron enough supplementation

Diagnosis of IDA:

1. CBC: it will revealed low in all of these test: hemoglobin (Hb), hematocrit (Hct), mean cellular volume (MCV), packed cell volume (PCV), ferritin, serum iron, iron saturation and High transferrin or total iron-binding capacity (TIBC)
2. The peripheral blood smear: or show small RBC(microcytic), has oval-shaped with pale centers (pencil shape).
3. Bone marrow study by using biopsy and Prussian blue stain to indicate poor iron storage.
4. Serum ferritin: test for iron stores
5. Serum iron is a medical laboratory test that measures the amount of circulating iron that is bound to transferrin, normally,1/3 of transferrin is saturated with iron, and this is the iron measuring in the plasma
6. Transferrin saturation: It is the value of serum iron divided by the total iron-binding capacity (TIBC) of the available transferrin bound.

Note: a total iron-binding capacity (TIBC) test measures the blood ability to attach itself to iron and transport it around the body. A transferrin test is similar. In iron deficiency anemia, iron level will be low but your TIBC will be high.

Lab findings of iron profile

Test	Normal value
Serum iron	50_150 mcg/dl
Serum ferritin	15-300 mcg/l
Serum transferrin saturation	30_40 %
Total iron binding capacity (TIBC)	310-340 mcg/dl
Red cell protoporphyrin	30_50 mcg/dl