Iron Total (Fe), Total Iron

Hematology Lab Tests

Sample

1. The test is done on the serum of the patient.
2. Collect the blood sample in the morning.
3. Avoid food at least for 12 hours before giving the blood.

Purpose of the test (Indications)

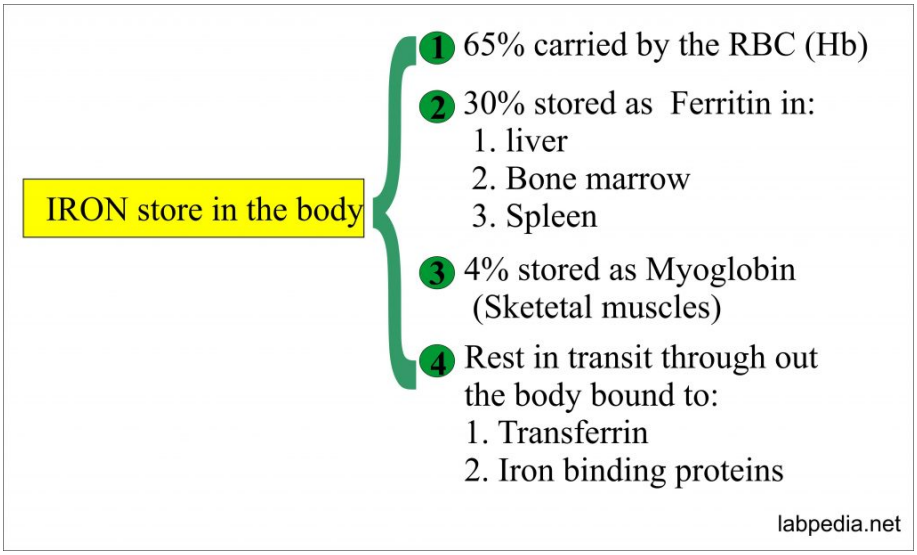
1. This test is done to evaluate the concentration of iron in the body.
2. This test will give information about the deficiency or overdose of iron.
3. This is advised in the workup of anemia.

Precautions

1. Avoid hemolysis because iron of the RBCs may increase the iron level.
2. Please get the history of blood transfusion in a recent period of time.
3. The hemolytic disease may give false high value.
4. The Recent history of iron-containing food or medication will affect the result.
5. Get the history of drugs which may decrease the value like chloramphenicol, methicillin, colchicine, ACTH, testosterone, and deferoxamine.
6. Get the history of drugs which may increase the level of iron like Estrogen, dextran, ethanol, iron preparation, methyldopa, and oral contraceptives.

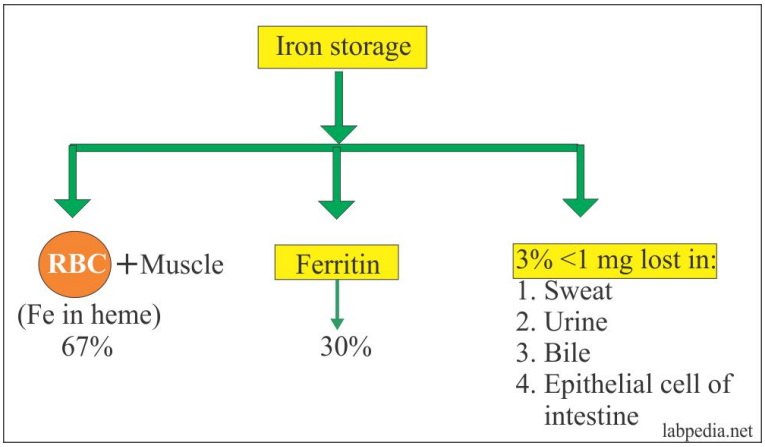
Pathophysiology

1. Iron is just like a trace element present in the body. Normally there is a very small amount in the cells, plasma, and other body fluids.
2. Iron is distributed in the body in different compartments like:
    1. Hemoglobin (70 % of the body).
    2. Tissue iron.
    3. Myoglobin.
    4. Labile pool.
    5. The other 30% is present in the form of ferritin and hemosiderin.



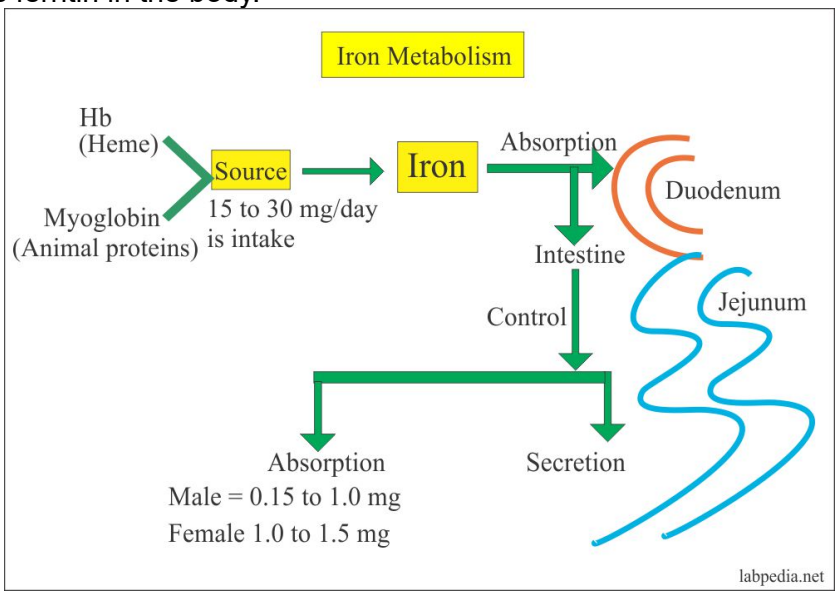
Different Sites of the Iron Storage

3. Approximately 2.5 G iron is present in hemoglobin.

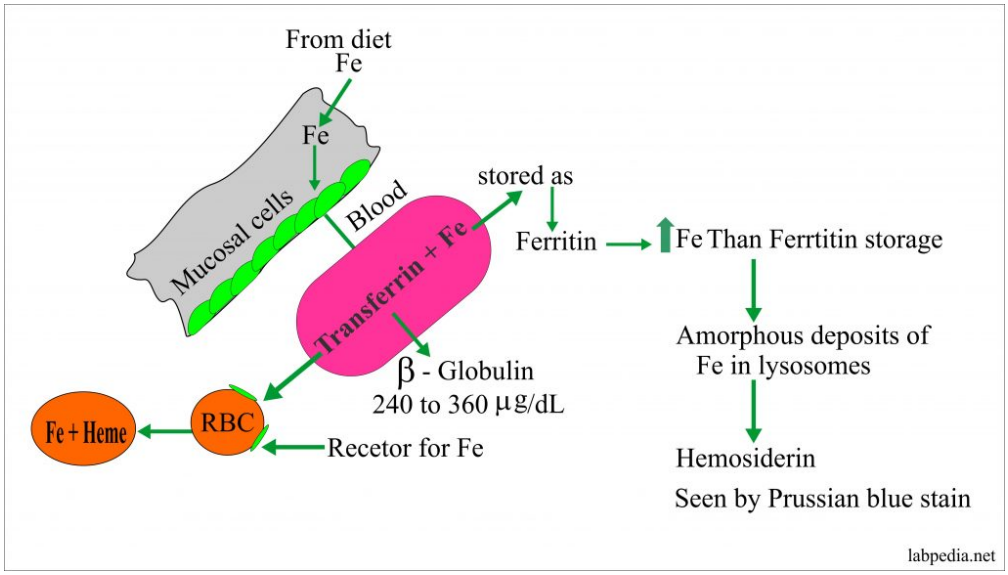


Different Forms of Iron Storage

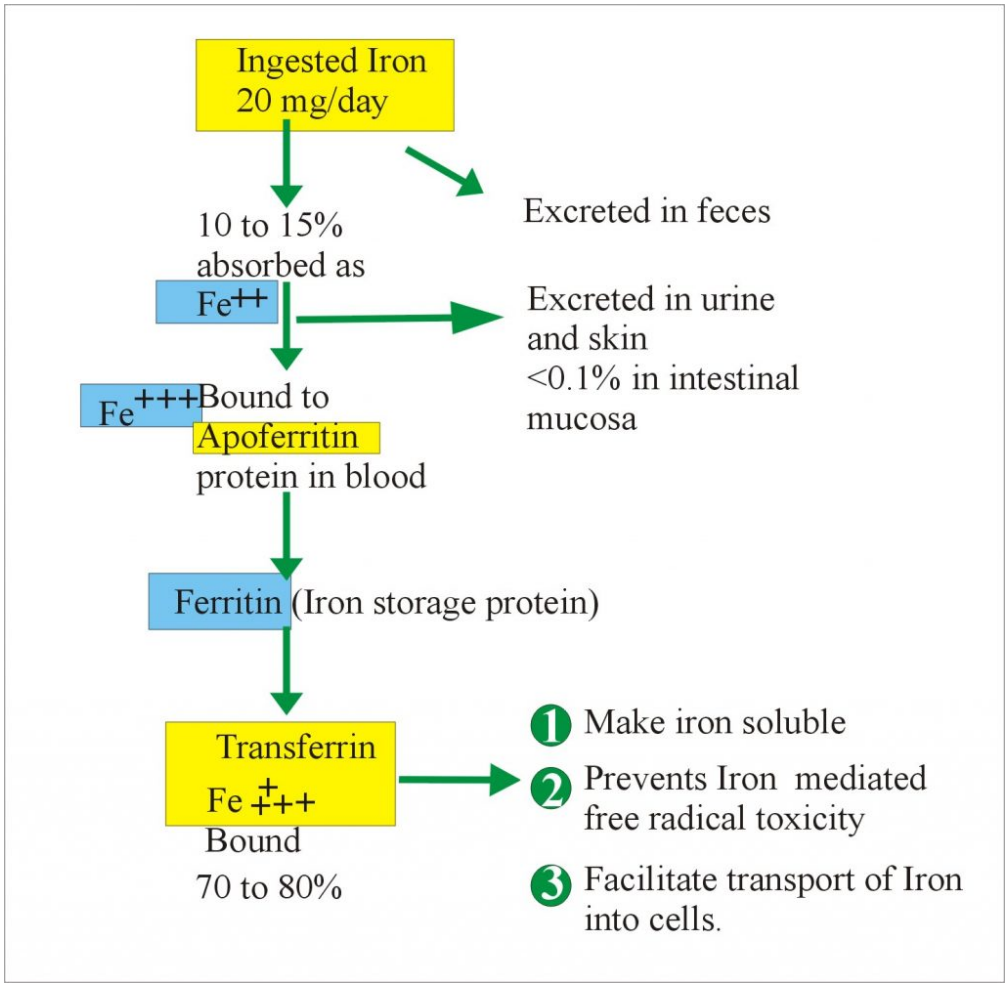
4. In plasma total amount of 2.5 mg iron is present.
    1. The iron is taken as ferric form and it changes to the ferrous form in the stomach by the Hydrochloric acid.
    2. It is then absorbed mainly in the small intestine.
    3. The leftover is excreted in the feces.
    4. It then combines with the apoferritin which the protein and make a complex of ferritin.
    5. Iron is stored as ferritin in the body.



Iron Metabolism and Absorption



Iron Absorption and Distribution in the Body

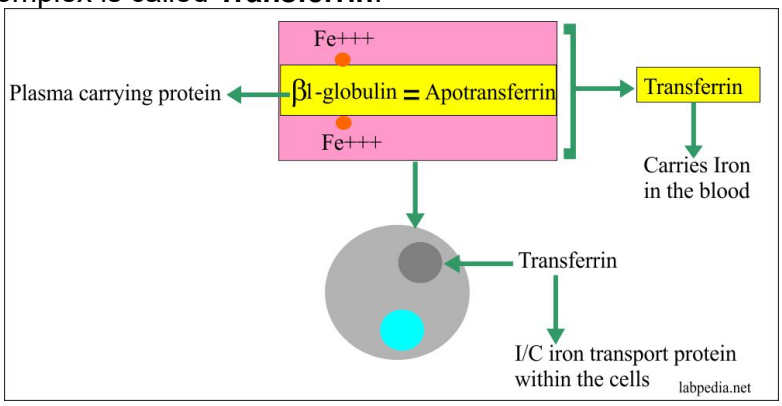


Iron Metabolism in the Body

1. Now Ferric ions combine with the Transferrin which is synthesized in the liver.
2. **Transferrin** helps:
    1. Make an iron insoluble form.
    2. It prevents iron-mediated free radical toxicity.
    3. This facilitates iron transport into the cells.

5. **Transport of iron**

1. Plasma protein **apo-transferrin** transport iron from one organ to another organ.
2. This apo-transferrin is beta 1-globulin. It has two sites to attach to iron.
3. Apoferritin + Fe complex is called **Transferrin**.

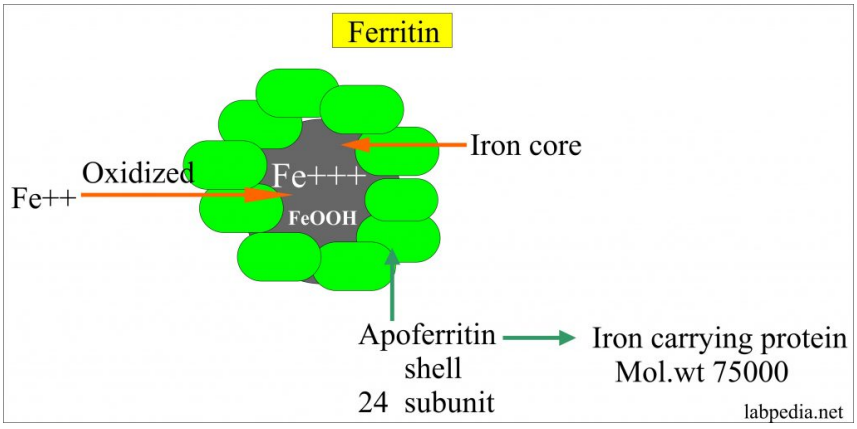


Transferrin Molecule and Its Function

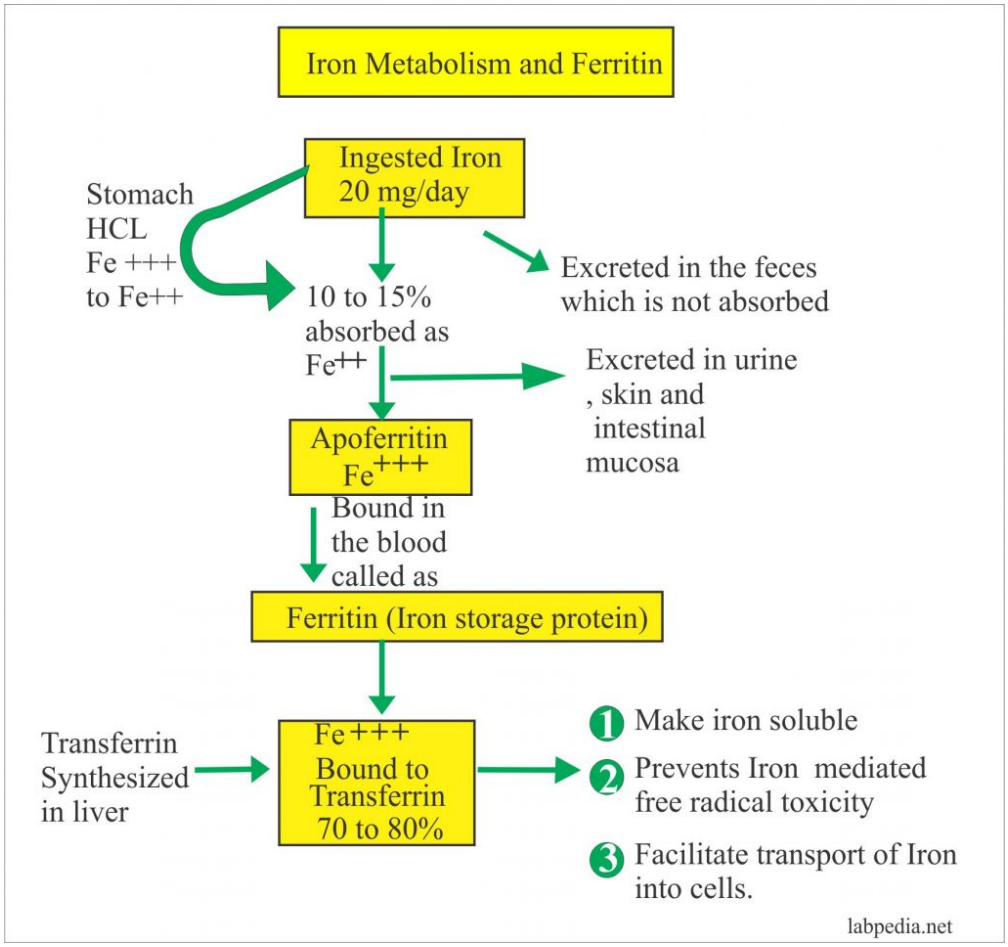
One molecule of transferrin binds = Transferrin + 2 Fe ++

Transferrin and binding of an iron molecule

4. **Ferritin** is the storage form of iron = Apoferritin shell + ferric oxyhydroxide FeO(OH).
    1. Ferritin is found almost in all cells of the body.
    2. Iron is supplied in the diet and 10 % of ingested iron is absorbed in the small intestine and transported to plasma.
    3. Iron in plasma is bound to globulin called Transferrin → enters bone marrow incorporate into → hemoglobin.
    4. Ferritin in liver cells and macrophages is the reserve for hemoglobin and another hemoprotein.
    5. Men's total ferritin store is 800 mg.
    6. Women's total ferritin stored varies from 0 to 200 mg.
        1. Ferritin concentration decreases before the is a drop in the hemoglobin, and changes in the RBCs morphology or serum iron concentration.



Ferritin Structure



Iron Metabolism

1. **Hemosiderin** is also stored in the form of the iron.
    1. This is aggregated, partially deproteinized ferritin.
    2. This is insoluble in the aqueous solution.
    3. This is found in the liver cells, spleen, and bone marrow.
    4. On-demand, it is released slowly.
2. Iron needed for the formation of hemoglobin.
3. **Abnormal level of iron causes:**
    1. Iron deficiency anemia.
    2. Overdose causes hemochromatosis.
    3. Iron overload is seen in:
        1. Hemosiderosis.
        2. Hemochromatosis, which is seen as an injury to the organs and there are degeneration and fibrosis.
        3. Sideroblastic anemia is due to iron overload and no exact mechanism is known.
4. 70% of iron is found in the hemoglobin of RBCs.
    1. 30% of iron stored in the form of :
        1. Ferritin.
        2. Hemosiderin.
5. Iron is supplied to the body in the diet. Where 10% of iron is absorbed in the small intestine and delivered to the blood.
6. Transferrin = Iron + globulin (Iron is bound to globulin).
7. Transferrin goes to Bone marrow and Form hemoglobin.
8. Serum iron is iron bound to transferrin.

Normal

Source 1

Age	µg/dL	
Newborn	100 to 250	
Infant	40 to 100	
Child	50 to 120	
Intoxicated child	280 to 2550	
Fatally poison child	>1800	
Adult	**Male**	**Female**
	65 to 175	50 to 170

- To convert into SI unit x 0.179 = µmol/L

Source 2

- Male = 80 to 180 µg/dL.
- Female = 60 to 160 µg/dL.
- Newborn = 100 to 250 µg/dL.
- Child = 50 to 120 µg/dL.

Lab Tests Significance

1. Measurement of total iron, iron-binding capacity, and transferrin saturation, should not be requested for iron deficiency.
2. The above tests are only useful in the screening of chronic iron overload diseases.
    1. Confirmation and monitoring of acute iron poisoning in the children.

Increased Serum Iron Level Is Seen In:

1. Hemolytic anemias.
2. Hemochromatosis or hemosiderosis.
3. Multiple transfusions.
4. An overdose of iron therapy.
5. Nephritis.
6. Liver damage and acute hepatitis.
7. Vit.B6 deficiency.
8. Lead poisoning.
9. Acute leukemias.
10. Iron overload syndrome.

Decreased Serum Iron Level Is Seen In:

1. Iron deficiency anemia.
2. Inadequate absorption of iron.
3. Chronic blood loss.
4. Paroxysmal nocturnal hematuria.
5. Pregnancy mostly in the third trimester.
    1. There is a 30% decrease in the iron after every menstrual cycle.
6. Chronic diseases e.g. chronic infections, autoimmune diseases like SLE, and rheumatoid arthritis.

7. Remission of pernicious anemia.
8. Inadequate absorption from the intestine like malabsorption.
9. Short bowel syndrome.
10. Malignancies.
11. Chronic hematuria.

- **Note:** Serum iron should be advised along with total iron-binding capacity and transferrin. Please see more details on Total iron-binding capacity and Transferrin.