IRON AND ITS METABOLISM

(SOURCES, ABSORBTION, DISTRIBUTION IN THE BODY, BIOMEDICAL FUNCTIONS AND EXCRETION)

Iron is the 26^{th} atom in the periodic table with a molecular weight of approximately 56. It is the most abundant trace element as it is present in most cells of the body, plasma and the ECF.

Iron is an absolute requirement for most forms of life ,it serves numerous functions in the body especially relating to the transport of O_2 in Hb. Its unique ability to serve as both an electron donor and acceptor (and bind electronegative elements like nitrogen, oxygen and sulphur) makes it important in many life processes.

It exists in two states of oxidation in the body which are the ferric form (Fe^{3+}) and the ferrous form (Fe^{2+}). Fe^{3+} is favored at neutral PH while Fe^{2+} is favored in more acidic PH. When in the Fe^{3+} state, iron will form large complexes with anions, water and peroxides.

SOURCES

Hemoglobin , myoglobin and other heme proteins in meat, liver, blood meal and other animal protein as well in lima, soy and kidney beans, spinach, tuna, wheat, millet and oats and so on.

ABSORBTION

Heme iron, contained mainly in animal products, is absorbed much better than non-heme iron (vegetable iron) which accounts for over 85% of iron in the average diet. However, absorption of non-heme iron is increased when it is consumed with animal protein and vitamin C.

Most intestinal iron absorption occurs in the duodenum and jejunum (the first two sections of the small intestine). Iron uptake is tightly controlled to prevent iron overload, so only 6-12% percent of dietary iron is absorbed by the intestines. Free iron in the intestines is reduced from the ferric (Fe^{3+}) to the ferrous (Fe^{2+}) state on the luminal surface of intestinal enterocytes and transported into the cells through the action of the divalent metal transporter, DMT1, intestinal uptake of heme iron occurs through the interaction of dietary heme with the heme carrier protein (HCP1).

The iron in the heme is then released within the enterocytes via the action the heme catabolizing enzyme heme oxygenase.

Iron is transported across the basolateral membrane of intestinal enterocytes into the circulation, through the action of the transport protein ferroportin, another enzyme hephaestin (a copper-containing ferroxidase with homology similar to ceruloplasmin), oxidizes the ferrous form back to the ferric form. Once in the circulation, ferric form of iron is bound to transferrin and passes through the portal circulation of the liver.

BODY DISTRIBUTION OF IRON

Iron is distributed in several compartments in the body, they are;

1. Hemoglobin ; which contains 0.34% of Fe by weight found within the RBCs.
2. Tissue iron; this is in the form of cellular enzymes and coenzymes either as part of the molecule or as a cofactor e.g. peroxides and cytochromes. All the iron within nucleated cells are referred as tissue iron.
3. Myoglobin; is a muscle protein containing iron similar to hemoglobin but does not occur as tetrameres.
4. Labile pool; this is iron found in no clear anatomical locations within the body.

Transferrin, synthesized in the liver, is the serum protein responsible for the transport of iron. Although several metals can bind to transferrin, the highest affinity is for the ferric (Fe^{3+}) form of iron. The ferrous form of iron does not bind to transferrin. Transferrin can bind two moles of iron. It can also serve as intracellular transporter o iron within the cell.

Ferritin is the major protein used for intracellular storage of iron. Ferritin without bound iron is referred to as apo-ferritin. Apo-ferritin is a large polymer of 24 polypeptide subunits. This multimeric structure of apo-ferritin is able to bind up to 2,000 iron atoms in the form of ferric-phosphate. The majority of intracellularly stored iron is found in the liver, skeletal muscle and reticuloendothelial cells.

Excess iron is toxic and may damage the intestines and other organs, as well as cause vomiting and diarrhea hence need for strict regulation of its absorption, the body's complex system of iron regulation and ferritin recycling ensures that as little iron is excreted as possible.

FUNCTIONS

EXCRETION

Excess dietary iron is not absorbed or stored in intestinal enterocytes but is excreted in feces. As little iron is excreted as possible normally, most being recycled or stored in the body for later use. However losses do occur through the intestines, skin cell exfoliation, sweat and urine. Bleeding can also deplete iron reserves, necessitating enhanced activation of iron absorption machinery.