COPPER

Copper

The body contain about 100mg of copper distributed in different organs. It is involved in several important functions.

- Copper is present in muscles , brain , kidney , heart and in hair .
- Whole blood contains about 100 microgram / dl 0f copper .Out of this 95% is in RBC as colourless erythrocuprein .
- In plasma ceruloplasmin is an important copper containing protein .
- Ceruloplasmin is a blue coloured glycoprotein , it is also called serum ferroxidase . It promotes oxidation of ferrous ion into ferric form which is incorporated into transferrin .

Copper

- Activates enzymes
- Aids in iron metabolism
- Absorbed in stomach and duodenum
- Excess excreted via billiary route
- Absorption decreased with high vitamin C, phytic acid, fiber, zinc, certain amino acids

Food Sources of Copper

- Meat
- Seafood
- Cocoa
- Mushroom, legumes, seeds, nuts, whole-grain

Functions of Copper

- Increases iron absorption
- Formation of connective tissue
- Formation of neurotransmitters
- Formation and maintenance of myelin
- In superoxide dismutase
- Immune system, blood clot, brain development, cholesterol metabolism

- FUNCTIONS OF COPPER
- **ROLE IN ENZYME ACTION**
- Copper is an essential constituent of several enzymes , these include cytochrome oxidase , catalase , tyrosinase ,super oxide dismutase (super oxide dismutase one molecule contain two ions of copper and two ions of zinc)
- Monoamine oxidase , ascorbic acid oxidase ,ALA synthase phenol oxidase and uricase .

- **ROLE IN IRON METABOLISM**
- Copper is essential for the formation of haemoglobin .
- Copper containing ceruloplasmin helps in iron transport.
- Copper is an integral part of ALA synthase , which is the key enzyme in heme synthesis Copper helps in the uptake of iron by normoblasts .
- Copper deficiency is manifested as anemia RBC count is reduced , cell size is small but haemoglobin concentration is more or less normal , this results in microcytic normochromic
- anemia if there is added iron deficiency hypochromic anemia results .

- **ROLE IN MATURATION OF ELASTIN**
- Copper is a constituent of lysyl oxidase .
- It oxidizes four lysine residues together to form desmosine
- Which makes cross linkages in elastin . In copper deficiency elastin becomes abnormal . leading to weakening of walls of major blood vessels .
- This favours aneurysm and fatal rupture of the wall of aorta . Another finding is the fibrosis of myocardium leading to cardiac failure .

- **Ceruloplasmin serves as ferroxidase** and is responsible for the convertion of iron from ferrous to ferric form .
- The form in which iron is transported in plasma ,

- **ROLE IN BONE AND MYELIN SHEATH OF NERVES**
- Copper helps in the formation of bones and maintenance of myelin sheaths of nerve fibre .
- **ROLE IN NON ENZYMATIC PROTEIN**
- Function unknown
- Hepatocuprein (storage form in liver)
- Cerebrocuprein (in brain)
- Hemocuprein (in RBC)

- **ROLE IN HEMOCYANIN**
- Hemocyanin is a copper protein in invertebrates , functions like hemoglobin for oxygen transport
- **ROLE IN MELANIN**
- Copper is present in tyrosinase which is necessary for melanin formation .
- Copper deficiency leads to hypopigmentation and in extreme cases grey colour of hair .
- The period of copper deficiency may be marked on hair as alternate white patches sometimes called flag type of hair growth .

ROLE IN BRAIN

- Low levels can cause brain dysfunction , especially of the cerebellum , leading to ataxia .

Dietary requirments

Adults ----- 2-3mg/day

Infants & children _____ 0.5-2mg/day

Absorption

About 10% of dietary copper is absorbed mainly in the duodenum.

Metallothionein is a transport protein that facilitates copper absorption. Phytate, Ze and molybdenum decreases' copper uptake.

Plasma Copper: The copper concentration of plasma is about 100-200mg/day. (95%) is tightly bound to ceruloplasmin while a small fraction (5%) is loosely held to albumin.The normal concentration of ceruoplasmin is 25-50mg/dl.

Who is at Risk For Deficiency?

- Preterm infants
- Undernourished infants
- Intestinal surgery
- Dialysis
- Burn patients

Disease states

- **Copper deficiency :** Severe deficiency of copper causes deminerlization of bones, demylination of neural tissue, anemia, fragility of arteries, myocardial fibrosis, hypopigmentation of skin, greying of hair.
- **Menke's disease:** This disorder is due to a defect in the intestinal absorption of copper. It is possible that copper may be trapped by metallothionein in the intestinal cells. The symptoms of menke's disease include decreased copper in plasma and urine , anemia and de- pigmentation of hair.

Disease states

Wilson's disease (hepatolenticular degeneration)

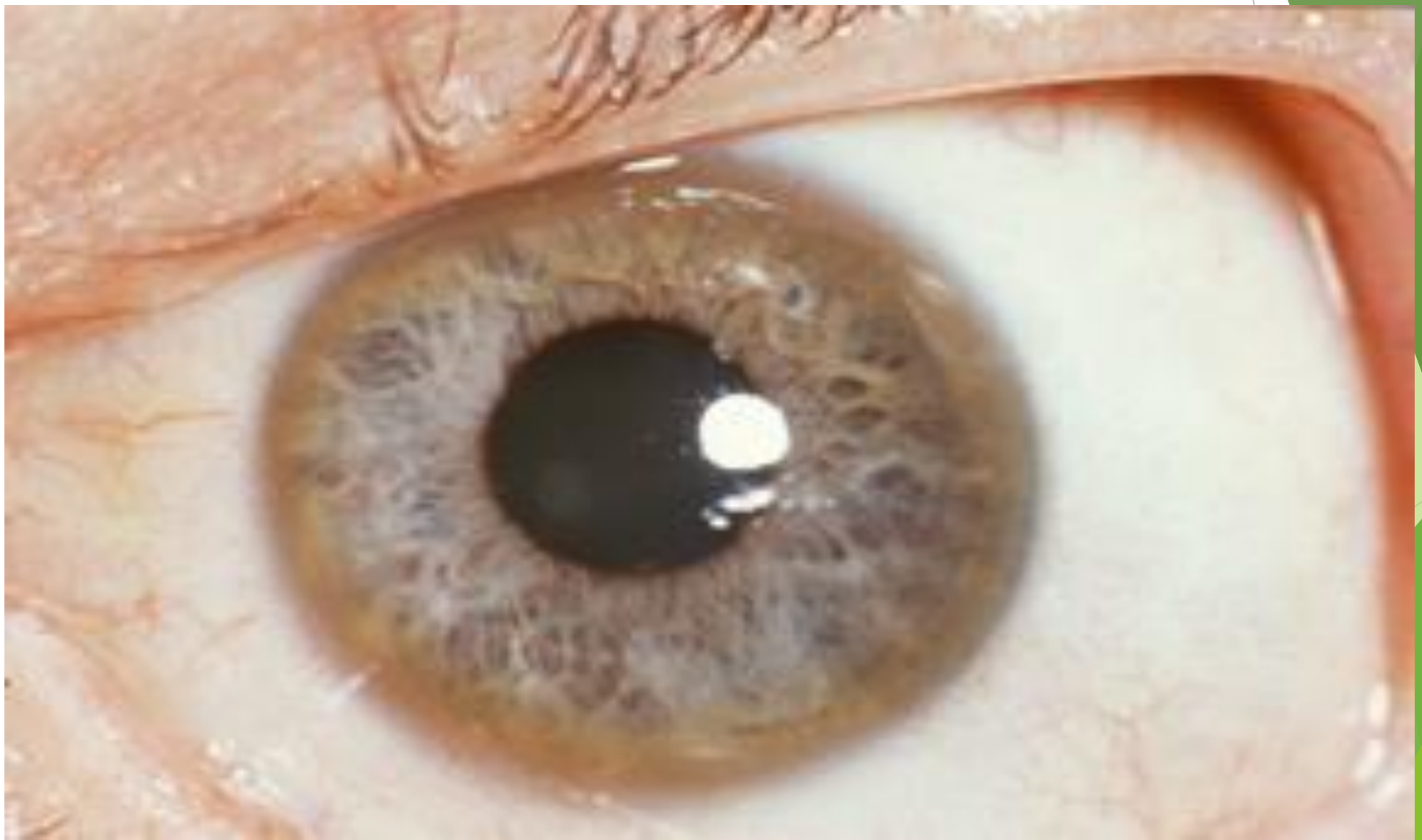
It is a rare disorder (1: 50,000) of abnormal copper metabolism and is characterized by the following mainfestations

- copper is deposited in abnormal amounts in liver and lenticular nucleus of brain. This may lead to hepatic cirrhosis and brain necrosis.
- Low levels of copper and ceruloplasmin in plasma (reference range 20-50 mg/dl) with increased excretion copper in urine.
- Copper deposition in kidney causes renal damage. This leads to increased excretion of amino acid, glucose, peptides and hemoglobin in urine.
- Intestinal absorption of copper is very high about 4-6 time higher than normal.

PROBABLE CAUSES OF WILSON DISEASE

- 1 A failure to synthesize ceruloplasmin or an impairment in the binding capacity of copper to this protein or both , so copper is free in the plasma which can easily enter the tissues and get deposited .
- 2 A mutation in the gene encoding copper binding Atpase is responsible for Wilson disease
- Defect in Atpase reduces intestinal excretion of copper through .

Kayser–Fleischer rings (KF rings) are dark rings that appear to encircle the iris of the eye. They are due to copperdeposition in part of the cornea (Descemet's membrane) as a result of particular liver diseases



Toxicity of Copper

- Upper Level is 10 mg/day
- nausea, vomiting,neurological manifestation.
- **Wilson's disease** accumulates copper in the liver, brain, kidneys, and cornea leading to premature death if left undetected.

- TREATMENT
- Administration of penicillamine , a naturally occurring copper chelating agent is used for the treatment of Wilson disease .