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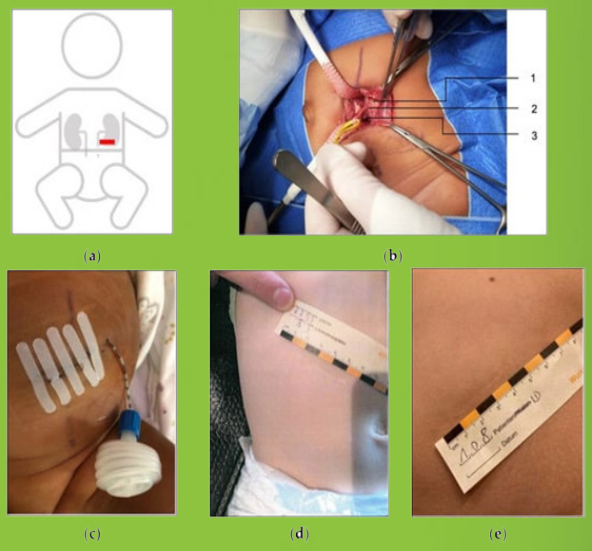
Case Report on Uretero Pelvic Junction Obstruction



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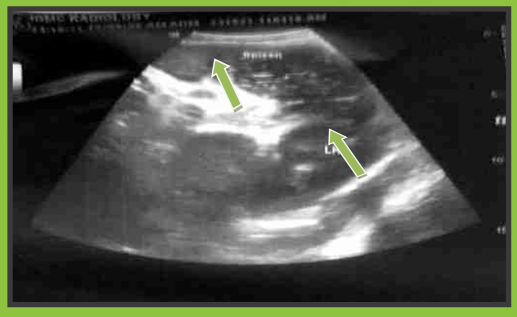
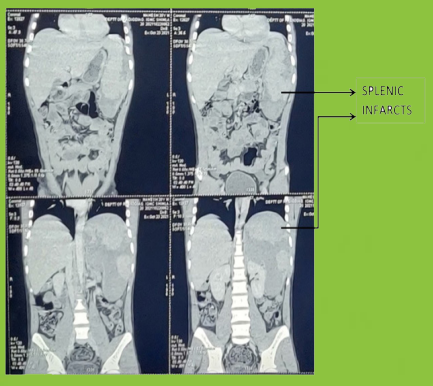
Tubercular splenic abscess in heterozygous sickle cell anemia and beta thalassemia trait -A rare presentation from Sub-Himalayan region





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H3N2 Virus and Precautions

GENERAL

Copper and Health

SANJAY AGRAWAL

Introduction

Copper (Cu) is a naturally occurring metal found in soil, water, and rocks. Nutritionally, it is an essential trace mineral found in some foods and in supplements. Copper has two oxidation states (cuprous, Cu+ and cupric, Cu2+) and is involved in cell oxidation and reduction reactions. The human body contains 100 mg of Cu, with~75% of the total in skeleton and muscle tissue, whereas the remainder is found in liver, brain, blood, heart, and kidney. (Ref.1)

Copper : Physiological functions

Copper is a critical functional component of several essential enzymes known as cuproenzymes. Some of the physiologic functions known to be copper-dependent are as follows:

Energy production

The copper-dependent enzyme, cytochrome c oxidase, plays a critical role in cellular energy production. (Ref.2)

Connective tissue formation

Another cuproenzyme, lysyl oxidase, is required for the cross-linking of collagen and elastin, which are essential for the formation of strong and flexible connective tissue. The action of lysyl oxidase helps maintain the integrity of connective tissue in the heart and blood vessels and also plays a role in bone formation (Ref.3).

Iron metabolism

Four copper-containing enzymes, known as multi-copper oxidases (MCO) or ferroxidases, have the capacity to oxidize ferrous iron (Fe2+) to ferric iron (Fe3+), the form of iron that can be loaded onto the protein transferrin for transport to the site of red blood cell formation. Adequate copper nutritional status is necessary for normal iron metabolism and red blood cell formation. Anemia is a clinical sign of copper deficiency.

Immune system function

Copper is known to play an important role in the development and maintenance of immune system function, but the exact mechanism of its action is not yet known. Neutropenia is a clinical sign of copper deficiency.

Central nervous system

A number of reactions essential to normal functioning of the brain and nervous system are catalyzed by cuproenzymes.

Neurotransmitter synthesis

Dopamine β-hydroxylase catalyzes the conversion of dopamine to the neurotransmitter, norepinephrine ((Ref.4).

Formation and maintenance of myelin

The myelin sheath is made of phospholipids whose synthesis depends on cytochrome c oxidase activity.

Melanin formation

The cuproenzyme, tyrosinase, is required for the formation of the pigment melanin. Melanin plays a role in the pigmentation of the hair, skin, and eyes.

Antioxidant functions

Superoxide dismutase and ceruloplasmin act as anti-oxidants and help provide protection against oxidative stress.

Regulation of gene expression

Cellular copper levels may affect the synthesis of proteins by enhancing or inhibiting the transcription of specific genes.

Copper and Health

Because dozens of enzymes use copper to perform metabolic processes throughout the body, it is believed that both an excess and deficiency of copper may interrupt these normal processes and a stable level is required for optimal health. The body is typically efficient at stabilizing copper levels (absorption increases if copper intake is low, and vice versa). Abnormal copper levels result from genetic mutations, aging, or environmental influences that may predispose to conditions such as cancer, inflammation, and neurodegeneration.

Cardiovascular system:

The cuproenzymes, superoxide dismutase and ceruloplasmin, are known to have antioxidant properties, leading some experts to propose that copper deficiency rather than excess copper increases the risk of cardiovascular disease (Ref.5).

Immune system:

Adverse effects of insufficient copper on immune function appear most pronounced in infants. Infants with Menkes disease, a genetic disorder that results in severe copper deficiency, suffer from frequent and severe infections (Ref.6). In a study of 11 malnourished infants with evidence of copper deficiency, the ability of white blood cells to engulf pathogens increased significantly after one month of copper supplementation (Ref.7).

Bone mineralisation:

Reduction in copper intake and absorption in older people reduces the activity of the copper-dependent enzyme, lysyl oxidase, which is required for the maturation (cross-linking) of collagen—a key element in the organic matrix of bone. A small study in perimenopausal women, who consumed an average of 1 mg of dietary copper daily,

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reported decreased loss of BMD from the lumbar spine after copper supplementation of 3 mg/day for two years (Ref.8). Additionally, a two-year double-blind, placebo-controlled trial in 59 postmenopausal women found that a combination of supplemental calcium and trace minerals, including 2.5 mg of copper daily, resulted in maintenance of spinal bone density. (Ref.9) .

Copper: RDA

The Recommended Dietary Allowances (RDA) for copper are:

- Birth to age 3: 200-340 micrograms (mcg)
- Ages 4-8: 440 mcg
- Ages 9-13: 700 mcg
- Ages 14-18: 890 mcg
- Ages 19 and older: 900 mcg
- Pregnancy and lactation: 1,300 mcg

Copper is found in highest amounts in organ meats, shellfish, fish, nuts, and seeds as well as whole grains and chocolate.

Copper : Deficiency

Clinically evident or frank dietary copper deficiency is relatively uncommon among healthy people and occurs primarily in people with certain genetic disorders, malnutrition, or malabsorption syndromes. Menkes disease is a rare genetic disorder wherein impaired copper absorption leads to severe copper deficiency. Copper deficiency may also occur due to excessive losses, as seen in severe burn patients or those with chronic kidney disease on dialysis, and after gastric bypass surgery for morbid obesity. Excessive zinc intake for prolonged period can also cause copper depletion.

Signs of deficiency include:

Copper depletion adversely affects cholesterol and glucose metabolism, blood pressure control and heart function, immunity, and mitigation of oxidative stress.

One of the most common clinical signs of copper deficiency is an anemia that is unresponsive to iron therapy but corrected by copper supplementation. Other symptoms of copper deficiency include neutropenia, immune dysfunction, increased risk of infections and osteoporosis, loss of skin and hair pigmentation and increased LDL/HDL cholesterol ratio (Ref. 10). Less common features of copper deficiency may include neurological symptoms, and impaired growth.

Copper : Clinical use

Copper is used clinically mainly to replete copper-deficient individuals. Copper gluconate, cupric sulfate, cupric oxide, or copper–amino acid chelates are most frequently used in supplements. Copper supplementation of at least 2 mg/d is recommended for Roux-en-Y gastric bypass patients (Ref.11)

Supplemental copper should be cautiously administered to infants, as toxicity risks are high. Patients with conditions that increase risk for copper toxicosis, including Wilson disease, biliary cirrhosis and atresia, should avoid taking supplemental copper.

Copper : Toxicity

Toxicity is rare in healthy individuals as the body is efficient at excreting excess copper. Although very rare, it is possible to consume excess copper, if continuously storing and then serving boiling liquids from corroding copper or brass vessels. Guideline values for copper in drinking water have been set by the US Environmental Protection Agency (1.3 mg/liter) and by the World Health Organization (2 mg/liter) (Ref.12). In generally healthy individuals, doses of up to 10,000 µg (10 mg) daily have not resulted in liver damage. For this reason, the US Food and Nutrition Board set the tolerable upper intake level (UL) for copper at 10 mg/day from food and supplements (Ref.13).

Copper toxicity has been seen with Wilson's disease, a rare genetic condition, that prevents copper from exiting the body and therefore leading to high blood levels. This results in severe liver damage, nausea, vomiting, diarrhea, and abdominal pain.

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