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**DEPARTMENT: PHARMACOLOGY**

**COURSE CODE: BCH 204**

**Question**

1. OUTLINE THE TOXICITY VALUES AND DEFICIENCY MANIFESTATIONS OF THE FOLLOWING MINERALS

A. POTTASIUM

B. CALCIUM

C. MAGNESSIUM

D. CHLORIDE

E. IRON

A. POTASSIUM

TOXICITY VALUES OF POTASSIUM

What is the toxicity of potassium?

High, acute potassium intakes have been associated with symptoms related to neuromuscular dysfunction, including weakness, paralysis, nausea, vomiting, and diarrhea. These symptoms, however, do not consistently develop prior to life-threatening cardiac arrhythmias.

DEFICIENCY MANIFESTATIONS OF POTASSIUM

I. Constipation

Potassium plays an important role in relaying messages from the brain to the muscles and regulating muscle contractions. Low potassium levels can affect the muscles in the intestines, which can slow the passage of food and waste. This effect on the intestines can cause constipation and bloating.

II. Muscle weakness

Potassium deficiency can affect other muscles in the body, including those in the arms and legs, which can lead to general muscle weakness and cramping.

A person loses small amounts of potassium through sweat, which is why heavy sweating from intense physical activity or being in a hot climate can often lead to muscle weakness or cramping.

III. Unexplained fatigue

Potassium is an essential nutrient that is present in all of the body’s cells and tissues. When potassium levels fall, this can significantly affect a wide range of bodily functions, which can lead to low energy levels and both physical and mental fatigue.

IV. High blood pressure

Low potassium levels can lead to an increase in blood pressure, particularly in people with a high sodium, or salt, intake. Potassium has an important role in relaxing the blood vessels, which helps lower a person’s blood pressure.

Potassium also helps balance sodium levels in the body. A diet high in sodium is a common cause of high blood pressure. Doctors often recommend that people with high blood pressure lower their sodium intake and increase their potassium intake.

V. Polyuria

The kidneys are responsible for removing waste products and regulating the levels of fluids and electrolytes, such as sodium and potassium, in the blood. They do this by passing waste and excess electrolytes out of the body in the urine.

Moderate-to-severe hypokalemia can interfere with the kidneys’ ability to balance fluid and electrolyte levels in the bloodstream, and this can lead to increased urination, which is called polyuria.

B. CALCIUM

Because of the large amount of calcium in bones, deficiency is rare1. Hypocalcemia (low serum calcium levels in blood) can result in tetany (involuntary muscle contractions)2. In addition, calcium deficiency in children can lead to rickets, which is a vitamin D deficiency. While not a deficiency, low calcium intake can lead to decreased bone mineral density and the conditions osteopenia and osteoporosis. How these differ from osteomalacia and normal bone is illustrated and described below. There are two different bone components that we will consider to understand what is happening in the bone. Matrix is the scaffolding onto which mineral is deposited. Mineral is at it sounds, the mineral that is deposited on the matrix.

Osteomalacia – Bone mass is normal, but the matrix to mineral ratio is increased, meaning there is less mineral in bone.

Osteopenia – Bone mass is decreased, but the matrix to mineral ratio is not altered from normal bone. This condition is intermediate in between normal and osteoporosis.

Osteoporosis – Bone mass is further decreased from osteopenia, but the matrix to mineral ratio is not altered from normal bone3.

The National Osteoporosis Foundation estimates that “about 54 million Americans have osteoporosis and low bone mass, placing them at increased risk for osteoporosis. Studies suggest that approximately one in two women and up to one in four men age 50 and older will break a bone due to osteoporosis.” To prevent osteoporosis it is important to build peak bone mass, 90% of which is built in females by age 18 and age 20 in males, but can continue to increase until age 30. After that time, bone mass starts to decrease. For women after menopause, bone mass decreases dramatically because of the decrease in estrogen production.

Combining the decrease after menopause along with the fact that women have lower bone mass to begin with, helps further explain why osteoporosis is more common in females. A measure of bone status is bone mineral density. As the name indicates, bone mineral density is a measure of the amount of mineral in bone. Dual energy X-ray absorptiometry (DEXA) accurately measures bone mineral density using a small amount of radiation.

C. MAGNESIUM

Hypermagnesemia is an electrolyte disorder in which there is a high level of magnesium in the blood. Symptoms include weakness, confusion, decreased breathing rate, and decreased reflexes. Complications may include low blood pressure and cardiac arrest. It is typically caused by kidney failure or is treatment induced such as from antacids that contain magnesium. Less common causes include tumor lysis syndrome, seizures, and prolonged ischemia. Diagnosis is based on a blood level greater than 1.1 mmol/L (2.6 mg/dL). It is severe if levels are greater than 2.9 mmol/L (7 mg/dL).Specific electrocardiogram (ECG) changes may be present.

Treatment involves stopping the magnesium a person is getting. Treatment when levels are very high include calcium chloride, intravenous normal saline with furosemide, and hemodialysis. Hypermagnesemia is uncommon. Rates may be as high as 10% among those in hospital.

D. CHLORIDE

Toxicity tests using nine freshwater species (Ceriodaphnia dubia, Daphnia magna, Oncorhynchus mykiss, Pimephales promelas, Lumbriculus variegatus, Tubifex tubifex, Chironomus dilutus, Hyallela azteca, and Brachionus calyciflorus) were conducted to evaluate their sensitivity to chloride. Acute-to-chronic ratios (ACRs) from these tests indicate the ACR of 7.59 employed by the United States Environmental Protection Agency (U.S. EPA) in deriving its water quality guideline for chloride may be conservative; a revised ACR of 3.50 is presented here. The endpoints used to calculate the ACR included 24-h to 96-h median lethal concentrations (LC50s) for acute tests, and 48-h to 54-d inhibition concentration (ICx) values for growth or reproduction for chronic exposures. Data from the present chronic toxicity tests, and other investigators, were used to propose a water quality guideline for long-term exposure to chloride using a species sensitivity distribution (SSD) approach. The 5th percentile from the SSD was calculated as 307 mg/L and proposed as the water quality guideline. Cladocerans were the most sensitive species in the dataset. Ceriodaphnia dubia was used to evaluate the relationship between water hardness and sensitivity to chloride. A strong relationship was observed and was used to establish a hardness-related equation to modify the proposed water quality guideline on the basis of water hardness, resulting in values ranging from 64 mg/L chloride at 10 mg/L hardness to 388 mg/L chloride at 160 mg/L hardness (as CaCO₃). These data suggest that current water quality guidelines for chloride may be overly conservative in water with moderate-to-high hardness, and may not be sufficiently protective under soft-water conditions.

DEFICIENCY MANIFESTATION

What Is Hypochloremia?

Hypochloremia is an electrolyte imbalance and is indicated by a low level of chloride in the blood. The normal adult value for chloride is 97-107 mEq/L.

Chloride in your blood is an important electrolyte and works to ensure that your body's metabolism is working correctly. Your kidneys control the levels of chloride in your blood. Therefore, when there is a disturbance in your blood chloride levels, it is often related to your kidneys. Chloride helps the acid and base balance in the body.

Causes of Hypochloremia:

Loss of body fluids from prolonged vomiting, diarrhea, sweating or high fevers.

Drugs such as: bicarbonate, corticosteroids, diuretics, and laxatives.

Symptoms of Hypochloremia:

Many people do not notice any symptoms, unless they are experiencing very high or very low levels of chloride in their blood.

Dehydration, fluid loss, or high levels of blood sodium may be noted.

You may be experiencing other forms of fluid loss, such as diarrhea, or vomiting.

Things You Can Do For Hypochloremia:

Make sure you tell your doctor, as well as all healthcare providers, about any other medications you are taking (including over-the-counter, vitamins, or herbal remedies). Do not take aspirin or products containing aspirin unless your healthcare provider permits this.

Remind your doctor or healthcare provider if you have a history of diabetes, liver, kidney, or heart disease.

Keep yourself well hydrated. Drink two to three quarts of fluid every 24 hours, unless you are instructed otherwise.

Avoid caffeine and alcohol, as these can cause you to have electrolyte disturbances.

Drugs That May Be Prescribed by Your Doctor:

As with most types of electrolyte imbalance, the treatment of low blood chloride levels is based on correcting the cause. If there is a dysfunction of your endocrine or hormone system, you may be referred to an endocrinologist for treatment. If there are problems with your kidneys, you may need to see a nephrologist.

If your low blood chloride levels are due to medications or treatments, these may be altered or removed, if possible.

When to Contact Your Doctor or Health Care Provider:

Nausea that interferes with your ability to eat, and is unrelieved by prescribed medication.

Vomiting (vomiting more than 4-5 times in a 24 hour period).

Diarrhea (4-6 episodes in a 24-hour period), unrelieved with taking anti-diarrhea medication and diet modification.

Severe constipation, unrelieved by laxatives, lasting 2 to 3 days.

Muscle twitching, irritability, increased urination, poor appetite that does not improve.

If you notice excessive sleepiness, confusion.

Return to list of Blood Test Abnormalities

Note: We strongly encourage you to talk with your health care professional about your specific medical condition and treatments. The information contained in this website is meant to be helpful and educational, but is not a substitute for medical advice.

E. IRON

TOXICITY VALUES

Toxic dose

Toxic effects begin to occur at doses above 10–20 mg/kg of elemental iron. Ingestions of more than 50 mg/kg of elemental iron are associated with severe toxicity. In terms of blood values, iron levels above 350–500 μg/dL are considered toxic, and levels over 1000 μg/dL indicate severe iron poisoning.

DEFICIENCY MANIFESTATIONS

iron deficiency anemia can be so mild that it goes unnoticed. But as the body becomes more deficient in iron and anemia worsens, the signs and symptoms intensify.

Iron deficiency anemia signs and symptoms may include:

Extreme fatigue

Weakness

Pale skin

Chest pain, fast heartbeat or shortness of breath

Headache, dizziness or lightheadedness

Cold hands and feet

Inflammation or soreness of your tongue

Brittle nails

Unusual cravings for non-nutritive substances, such as ice, dirt or starch

Poor appetite, especially in infants and children with iron deficiency anemia