CHROMIUM - TRACE ELEMENT

Introduction

Atomic mass 52. Chromium occurs as its oxide in chromite ore that also contains various amounts iron, aluminium and manganese. Chromium can exist in valency states 3+ and 6+ and each of these has significantly different properties. The oxidation state determines toxicity, metabolism and excretion.

Exposure

Chromium is present in a normal diet at trace (but essential) levels. Occupational exposure is related to the industrial uses of chrome compounds in production and use of steels, pigments, leather tanning, wood preservation solutions, plating chemicals and cement.

Chromium is present in solutions used for total parenteral nutrition as a contaminant. The use of such unsupplemented solutions has been reported to be associated with elevated serum chromium. The use of supplemented solutions (0.2 mg/kg) has been associated with serum chromium levels twenty-fold greater than controls.

Absorption

Cutaneous absorption of hexavalent forms has been demonstrated. Pulmonary absorption is related to water solubility. Very little chromium is absorbed in the gut.

Distribution

Chromium is oxidised or reduced to yield the chromium 3 ion that circulates as a transferrin complex. Chromium is distributed diffusely in the body with generally higher levels found in kidney, liver, spleen and blood. Chromium does not appear to cross the blood-brain barrier.

Excretion

Chromium is primarily excreted in the urine, a finding that accounts for the accumulation of the metal seen in renal failure.

Pathology

No cases of toxicity have been described for excessive intake in the diet. However, there have been reports of toxicity with Cr^{3+} picolinate (widely used in supplements) taken in doses many times that recommended (Cerulli J, Grabe DW, Gaithier I, Malone M, McGoldrick MD. Chromium picolinate toxicity. The Annals of Pharmacotherapy 1998;32:428-431).

Cr^{6+} is highly toxic when inhaled and may result in lung cancer, dermatitis and skin ulcers. It is much less toxic when exposure occurs orally because gastric fluids readily reduce Cr^{6+} to Cr^{3+}. Toxicity is predominantly associated with industrial exposures. The most common presentation is an allergic eczema primarily on the skin but occasionally in the lungs. Some types of industrial exposure have been linked to increased prevalence of lung cancers. Acute exposure to high chromium concentrations can cause renal damage.

Monitoring

Plasma chromium reflects recent exposure to hexavalent chromium and trivalent chromium. In contrast, red cell chromium levels represent exposure to hexavalent chromium during the lifetime of the erythrocyte, as only hexavalent chromium is able to enter red blood cells.

Total urinary chromium reflects absorption of chromium over the previous 1 – 2 days. Absorbed chromium demonstrates three clear half-lives of 7 hours, 20 days and 4 years. This should be taken into consideration when interpreting the data. Estimation of exposure risk is recommended over biological monitoring.

Chromium is an essential micronutrient and is suspected of playing a role in glucose tolerance. Impaired glucose tolerance has been reported in cases of suspected chromium deficiency. Normal serum chromium is at the limit of detection of current analytical systems. Where chromium is consistently undetectable there may be a case for cautious supplementation. Normal serum chromium levels are probably less than 8 nmol/L.

Samples taken for chromium determination are notoriously prone to contamination by the collection equipment and storage tubes. PaLMS Trace Element Service recommends the use of commercial certified trace elements collection tubes. Please contact the laboratory for more information on the detection of presumed deficiency or collection procedures.

Treatment

Recommended supplementation for chromium deficiency is 5-10 µg of chromic chloride daily for three days followed by 10µg weekly. Monitor improvement in glucose tolerance.

Analysis

Chromium concentrations are determined by inductively coupled plasma mass spectrometry.

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