

## MERCURY - TRACE ELEMENT

### Introduction

Atomic mass 201. Mercury exists in a number of forms, both inorganic ( $\text{Hg}^0$ ,  $\text{Hg}^+$ ,  $\text{Hg}^{2+}$ ) and organic (eg. methyl mercury). Mercury sulphide is the principal component of mercury ores. Mercury and its organic and inorganic compounds have been used in medicine for centuries as cathartics, desiccants, antiseptics, vermicides and diuretics. Phenyl mercuric compounds are used as fungicides. Mercury is a component of some materials used in dentistry. Mercury in the natural environment arises from out-gassing of mercury vapour from the earth's surface and burning of fossil fuels. Microorganisms that live in marine and freshwater sediments methylate mercury. Methyl mercury is concentrated up the food chain and can be present in high concentrations in top predators.

### Exposure

Occupational exposures occur during the mining and processing of mercury containing ores, the manufacture, use and disposal of scientific instruments, batteries and fungicides and in the production of mirrors, thermometers, incandescent lights, plastics, and x-ray machines as well as in paper whitener. Overexposure to mercury containing medications is potentially lethal and may occur due to misunderstanding over the use of the compounds, for example, the use of desiccants on open wounds. The major source of exposure to organic mercurials is seafood. Methyl mercurials are accumulated in the aquatic food chain (highest levels in predatory fish eg. shark, swordfish, tuna). The concentration of mercury in other food is very low.

### Absorption

Metallic mercury is readily absorbed by inhalation whereas little is absorbed after ingestion. Inorganic mercury compounds are also poorly absorbed from the gut. Organic mercury compounds are absorbed very well from either the lungs or the gut. Phenyl mercuric compounds may be absorbed through the skin.

### Distribution

Inorganic mercury compounds are lipid soluble. Once the compounds are absorbed, the divalent oxidation state is favoured and the compounds concentrate in the central nervous system (except the brain) and kidney. Inorganic mercury compounds are able to cross the placenta. Phenyl mercuric compounds behave in a similar fashion to inorganic mercurials. Methyl mercury is the predominant compound involved in organomercurial exposures. Methyl mercury is almost completely absorbed from the gut and is probably well absorbed through the lungs and skin. After absorption methyl mercury binds to haemoglobin, circulates systemically and is distributed to all organs (notably including the brain). Methyl mercury is directly incorporated into growing hair from the blood.

### Excretion

Inorganic mercury is excreted in the urine. Methyl mercury is secreted into the bile and mostly reabsorbed from the gut. Microbes demethylate a small proportion of the recirculating methyl mercury and the resulting inorganic mercury is excreted in the faeces.



## **Pathology**

Mercury toxicity is related to the method of exposure and the type of mercurial involved. Inorganic mercury that is ingested is essentially non-toxic. Inorganic mercury that is inhaled is a pulmonary toxin. Acute inhalation may result in metal fume fever, myalgia, metallic taste, headache and pneumonitis. Metal fume fever is characterised by fatigue, weakness, fever, chills, dizziness, headache, abdominal cramping, dyspnoea, dysuria and ejaculatory pain. As the metal enters the systemic circulation it rapidly produces blurred vision and encephalopathy. Acute exposure to inorganic mercurials produces inflammation of the mouth, oesophagus and lower gut. If the dose is sufficient, renal failure and death may occur.

Chronic exposure to inorganic mercury vapour may result in intention tremor, ataxia, dermatitis, gingivitis, salivation, stomatitis, erethism, loss of memory, lack of self-control, drowsiness and depression. Erethism is the constellation of irritability, excitability, anxiety, insomnia and social withdrawal. Erethism is traditionally seen in the chronic phase of toxicity. Renal toxicity may manifest as the nephrotic syndrome and/or tubular dysfunction.

Although there is an overlap with symptoms of inorganic mercury toxicity, the predominant features of organic toxicity include, paraesthesiae of extremities and/or perioral regions, visual, speech and hearing disturbances, deafness and ataxia. Exposure to methyl mercury produces neurotoxicity after a latent period of weeks to several months dependent on the extent of the exposure, with high doses associated with shortened latent periods.

## **Monitoring**

As the various mercury species partition differently, it is important to screen generally where mercury toxicity is suspected but the mercury species is unknown. If the mercurial involved is identified, then it is important to ensure the appropriate matrix is chosen for monitoring. Exposure to elemental or inorganic mercury will only produce modest changes in the blood while urine excretion will be elevated. Methyl mercury is excreted to the bile so exposure will not produce increased urinary mercury concentrations. Blood levels will, however, increase, as will the mercury content of growing hair.

## **Treatment**

Intramuscular BAL has been used to treat inorganic mercury poisoning. Its use is contraindicated in methyl mercury poisoning. Dimercaptosuccinic acid is a new drug that shows promise for the treatment of mercury exposures of all types.

## **Analysis**

Mercury is determined by inductively coupled plasma mass spectrometry.

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