

BIOLOGICAL PROPERTIES AND HEALTH EFFECTS OF ARSENIC

Biological Properties

Soluble inorganic arsenic compounds, such as arsenic trioxide, are readily absorbed from the intestine (80-90%). Organic arsenic compounds found in seafood are not well absorbed. Arsenic can also be absorbed through the lungs and skin. Most of the arsenic in the blood is bound to red blood cells. Once ingested, inorganic arsenic is biotransformed by the liver to a methylated form of arsenic and excreted in the urine with a half-life of 3 to 5 days. Arsenic is also excreted in the outer layer of skin cells and in sweat. Arsenic binds to sulfhydryl-containing proteins and concentrates in the hair and fingernails. At higher levels of exposure, white bands, called Mees' lines, are visible in the nails.

Health Effects

The acute effects of inorganic arsenic poisoning are well known from the incidence of suicidal, homicidal, and accidental poisonings. Ingestion of 70 to 180 mg of arsenic trioxide can be fatal, but initial effects may be delayed for several hours. Symptoms following oral ingestion include constriction of the throat with difficulty in swallowing, severe intestinal pain, vomiting, diarrhea, muscle cramps, severe thirst, coma, and death. If the patient survives the acute symptoms there is often peripheral nervous system damage.

The symptoms of chronic arsenic exposure are most often associated with contaminated drinking water. Early signs of arsenic exposure are garlic

odor on the breath, excessive perspiration, muscle tenderness and weakness, and changes in skin pigmentation.

More advanced symptoms include anemia, reduced sensation in the hand and feet from damage to the peripheral sensory system (stocking and glove syndrome), peripheral vascular disease, skin changes on palms and soles, and liver and kidney involvement. Changes in circulation can lead to [gangrene](#) of extremities, especially of the feet, which has been referred to as blackfoot disease. Hyperpigmentation and hyperkeratosis of palms and soles occurs in 6 to 3 months with repeated ingestion of 0.4 mg/kg per day. Many of the symptoms are dose and time dependent. In other words, repeated low levels of exposure over an extended period of time can produce effects similar to a one-time, high level of exposure.

Arsenic causes both skin and lung [cancer](#). Skin cancer was observed over 100 years ago in patients treated with arsenical compounds, and lung cancer was seen in smelter workers who chronically inhaled arsenic dust. Although arsenic is an established human carcinogen, it has been difficult to confirm and study in animal models. Arsenic readily crosses the placenta, but there appears to be increased methylation of arsenic to its organic form, which reduces its toxicity to the fetus.

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