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Arsenic Poisoning

Background and History

Arsenic has a long and diverse history of use. It is most famous for its use as a poison from Roman times to the mid-nineteenth century. Its lack of color, odor, and taste made it a favored poison. When ingested in high quantities, arsenic causes severe abdominal cramps, diarrhea, vomiting, and eventually, death. When ingested in small doses, symptoms mimic those of chronic illnesses, disguising the assassin's intent.

Arsenic poisoning was such a widespread concern that the Roman Consul Lucius Cornelius Sulla issued the *Lex Cornelia* in 82 B.C. outlawing arsenic poisoning. However, The Borgias, led by Cesare Borgia and his father Pope Alexander VI, assassinated numerous wealthy cardinals and popes and, by church law, acquired holdings and money of the deceased. The Borgias became some of the richest men in all of Italy, but they themselves succumbed to the poison. Napoleon is also rumored to have died of arsenic poisoning, though the debate is highly contentious and continues to this day. (See *Napoleon's Death by Arsenic Exposure...?* for a detailed description of the debate.) The use of arsenic as a poison began decreasing in the 18th century, when English chemist James Marsh developed a chemical test that identifies arsenic in the body.

The use of arsenic as a pesticide began in the late nineteenth century. Though the majority of arsenic-based pesticides are no longer used in agriculture or horticulture in the U.S., arsenic-based wood preservatives are still used in nonresidential construction. (EPA banned residential uses of arsenic-based wood preservatives in 2004).

Symptoms

The symptoms of arsenic exposure are a perfect example of the dose-response relationship. Symptoms depend upon:

- amount of arsenic
- length of exposure
- individual sensitivity to the effects of Arsenic

Acute Exposure

Short-term exposure to larger amounts of Arsenic can cause:

- swelling of the face
- acute stomach pain/convulsions
- vomiting
- diarrhea

- internal bleeding
- coma
- death

Chronic Exposure

Long-term exposure to smaller amounts of Arsenic can cause:

- Cancer
- nerve damage
- skin pattern changes

Routes of Exposure and Metabolism

Arsenic is absorbed primarily through ingestion, but it may be absorbed through the skin (mainly from touching treated wood) or inhaled.

Once arsenic enters the body, the primary detoxification mechanism is Biomethylation, which converts the arsenic from its most-toxic inorganic forms to less-toxic organic forms (#Roy and Saha, 2002). The arsenic that remains is then either excreted in the urine or stored in cells.

Testing

The first test was the Marsh Test, developed in 1836 by English chemist James Marsh. Most arsenic remains in the body for a short time, therefore the best way to determine arsenic exposure is to measure the amount excreted in urine. There are two tests available today (#DOH Fact Sheet). The first test measures the total amount of arsenic in the body, making no distinction between the harmful inorganic forms and the harmless organic form. The second test measures only the inorganic arsenic that has passed through the body, and is a better indicator of overall health. Tests that measure arsenic levels in hair and fingernail samples are also available; these may help evaluate long-term arsenic exposure but are not widely used because of problems with accuracy.

Notable Cases

- Napoleon
- The Borgias
- Grand Duke of Tuscany Francesco

External Links

- Dartmouth Toxic Metals Research Program Page on Arsenic
- Harvard Arsenic Foundation
- eMedicine on Arsenic Poisoning

References

- Pradash Roy and Anupama Saha, "Metabolism and Toxicity of Arsenic: A Human Carcinogen," *Current Science* 82, (January, 2002), p. 38-45.
- Washington State Department of Health. "Fact Sheet: Arsenic in the Environment. June, 2003.