



The Blue Ridge Poison Center

Tox Talks

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A Bulletin for Health Care Professionals Who Manage Poisoned Patients |

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Heavy Metal Testing

Numerous heavy metals are associated with human toxicity and include such elements as arsenic, antimony, bismuth, cadmium, chromium, cobalt, copper, gold, iron, lead, manganese, mercury, selenium, silver, thallium, tin, and zinc. Some metals (e.g., copper, iron, selenium) are essential for cellular function but toxic in high doses, some metals (e.g., bismuth) are used in medicines at specific doses but are toxic at higher doses, and some metals serve no purpose in the body and are considered solely as toxins at any level (e.g., cadmium, lead). The specific clinical effects of metals on the body depend on a number of factors, such as the dose and the duration of exposure. Testing for metal toxicity can be complex, depending on the specific metal and its form (e.g., elemental, inorganic, organic). Clinicians need to be careful with the choice of heavy metal testing and should be based on the patient exposure risk (e.g., occupation), the patient's clinical effects, and the timing of the presumed exposure.

Clinicians should be aware that the majority of hospital heavy metal urine screens test for only 3 metals: 1) arsenic; 2) lead; 3) mercury. This urine test has limited utility in clinical practice. There are numerous other heavy metals besides these three that can cause clinical health problems that are not part of this urine heavy metal screen (e.g., the clinical course of antimony and selenium toxicity resembles arsenic toxicity; thallium toxicity can cause a painful neuropathy resembling arsenic and mercury toxicity). In addition, the state of the metal also matters. For

example, organic arsenic (e.g., arsenobetaine) found in seafood does not cause clinical toxicity, but the urine heavy metal screen will test positive for arsenic following an ingested shrimp meal because the screen does not differentiate organic from inorganic arsenic.

Arsenic

The most reliable diagnostic test for inorganic arsenic is a quantitative 24-hour urinary arsenic excretion. The collection of urine for such a test requires a specific container to avoid contamination. Blood arsenic is rarely useful as it may be elevated initially in an acute poisoning, but levels rapidly decline within 1 to 2 days, despite continued symptoms and increased urinary arsenic excretion.

Mercury

The most reliable diagnostic test for inorganic and elemental mercury is a quantitative 24-hour urinary mercury excretion. In inorganic and elemental mercury poisoning, blood mercury levels have limited utility due to inorganic and elemental mercury's short elimination half-life in the blood. Unlike inorganic and elemental poisoning, organic mercury is best identified by analysis of whole blood. Methylmercury, for example, is bound to hemoglobin (>90%) and is primarily eliminated in the bile, therefore urinary mercury levels are unreliable following organic mercury toxicity.

Lead

The most reliable diagnostic test for lead is a venous blood lead level (BLL) and should be utilized rather than a urine testing. Lead is poorly eliminated from the body (>90% is deposited into bone). For example, all children that fit into a high-risk category (see VDH's Lead-Safe Virginia website for criteria - <http://www.vdh.virginia.gov/leadsafe/>) should be screened with a BLL at 1 and 2 years of age.

“Urine mobilization test,” “challenge test,” and “provoked urine test” are all terms used to describe the administration of a chelating agent to a person prior to collection of their urine to test for metals. There is no standard, validated challenge test. Despite recommendations by professional and government organizations against the use of provoked urine testing, the tests are still commonly used and recommended by some practitioners. Current evidence clearly does not support the use of chelation challenge tests for the diagnosis of metal toxicity and these tests should not be utilized (For further information, please see Dr. Ruha's article entitled “Recommendations for provoked challenge urine testing” in the *Journal of Medical Toxicology* (2013;9:318-25))

Heavy metal testing should always be performed in a certified laboratory. Numerous non-certified laboratories exist and the results should never be trusted as valid from such laboratories. For more information on laboratories performing nonstandard tests, please see QuackWatch (<https://www.quackwatch.org/01QuackeryRelatedTopics/Tests/nonstandard.html>).

Due to the complexity of heavy metal testing, clinicians can consider talking with a Medical Toxicologist at the Blue Ridge Poison Control Center: 1-800-222-1222 prior to ordering urine heavy metal screening.