Mercury

Atomic number 80
Atomic weight 200.59

Collection

Blood	5 mL	Plastic container EDTA anticoagulant
Urine	20 mL	Sterile Universal

Measurement of mercury in blood is preferred where there is exposure to organic mercury
Measurement of mercury in urine is preferred where there is exposure to mercury vapour or inorganic mercury salts.

Reference ranges

			Reference
Serum/plasma			
Blood	nmol/L	Less than 25	1,2
Urine	nmol/L	Less than 25	3,4
	nmol/L	9-14	7,8
	nmol/24 h	Less than 15	5
	nmol/mmol creatinine	Less than 3	4-6
	µmol/mol creatinine	1.5 95th percentile	8

Notes
HSE Health Guidance Value for occupational exposure to inorganic mercury: 20 nmol/mmol creatinine

References

1. Batariova A, Spevackova V, Bohuslav B, Cejchanova M, Smid J, Cerna M. Blood and urine levels of Pb, Cd and HG in the general population of the Czech Republic and proposed reference values. Int J Hyg Environ Health 2006; 209: 359-366
2. Wilhelm M, Ewers U, Schulz C. Revised and new reference values for some trace elements in blood and urine for human biomonitoring in environmental medicine. Int J. Environ Health 2004; 207; 69-73
3. Benes B Spevackova V, Smid J, Cejchanova M, Kaplanova E, Cerna M, Gajewska V, Blatry J. Determination of normal concentrations of Cd, Pb, Hg, Cu, Zn and Se in urine of the population in the Czech Republic. Cent Eur J Public Health 2002; 10: 3-5
4. NHANES CDC (2009) Fourth National Report on Human Exposure to Environmental Chemicals, Department of Health and Human Services Centers for Disease Control and Prevention.
5. Sieniawska C et al. Twenty-four hour urinary trace element excretion: reference intervals and interpretive issues. Ann Clin Biochem 2012; 49: 341-51.
6. Berglund M, Lind B, Bjornberg KA, Palm B, Einarsson O, Vahter M. Interindividual variations of human mercury exposure biomarkers: a cross sectional assessment. Environmental Health: A global access science source. 2005; 4: 20
7. Hoet P. Jaquerye C, Deumer G, Lison D, Haufroid V. Reference values and upper reference limits

for 26 trace elements in the urine of adults living in Belgium. Clin. Chem. Lab. Med. 2013; 51: 839-849.

8. Morton J, Leese E, Tan E, Cocker J. Determination of 61 elements in urine samples collected from a non-occupationally exposed UK adult population, Toxicol. Letters 2014; 231: 179-193.

Clinical

Mercury and its compounds have been used by man for many hundreds of years and their toxicities are well recognised. Metallic mercury is used in the manufacture of thermometers and scientific instruments, and in the electrical, electronic and chemical industries. Inorganic and organic compounds of mercury are widely used as anti-bacterial and anti-fungal agents in the form of liquids, powders and paints. Mercury is unique among the metals in being a liquid with a measurable vapour pressure at ambient temperatures.

Use of liquid mercury in religious practices of Caribbean origin has been reported in the USA and the element may also be a component of Indian sub-continental ethnic remedies.

Toxicity

Ingestion of metallic mercury appears to be relatively harmless with little intestinal absorption. However, metallic mercury presents a considerable hazard by virtue of the possible inhalation of its vapour, even at ambient temperature. Inhalation of a high concentration of mercury vapour may give rise to pneumonitis and pulmonary oedema which can be fatal. Chronic exposure to lower concentrations causes gingivitis and stomatitis with excessive salivation, headaches and central nervous system effects with tremor and personality changes. Ingestion of inorganic salts produces abdominal pain, diarrhoea and vomiting and corrosion of mucosal membranes. The kidney is the major target organ for inorganic mercury following absorption, with renal tubular necrosis the result. Some elemental mercury is oxidised to the inorganic form and may produce renal toxicity. An idiosyncratic response to any form of mercury exposure is glomerulonephritis with immune complexes detected in the basement membrane

Use of mercury is widespread in dentistry as a tooth filling in the form of an amalgam prepared by mixing metallic mercury with a silver-tin alloy. Increased urinary excretion of mercury has only been observed immediately after extensive fillings but there appears to be little evidence of long term hazard to the patients involved, even when corrosion and break-down of the amalgam takes place. However, the preparation of such amalgams can be hazardous to dental personnel if insufficient care is taken; cases of poisoning in dentists and their assistants have been reported. Symptoms from mild long-term exposure may be very nonspecific in the form of headaches and irritability. Modern practice within dental surgeries, where mercury is contained within sealed capsules prior to formation of amalgam, has essentially eliminated the vapour hazard.

One of the most toxic mercury compounds is methylmercury, which is widely used as an antifungal agent. Its toxicity results from its lipophilic properties, which allow its rapid penetration through the body, particularly into the brain and nervous tissue. It is slowly metabolised to inorganic mercury and the biological half-life is some 70 days. Widespread toxicity has occurred in several countries, where wheat treated with methyl mercury and intended for use as seed was used to make bread. Inorganic mercury may be converted by bacteria into methylmercury, and such a transformation was responsible for a major outbreak of poisoning in the Minamata Bay area of Japan. In this case, inorganic mercury from an industrial plant was released into a river, where it was transformed biologically into methylmercury, producing a high level in the fish consumed by local people. Central nervous system toxicity was the main effect, with ataxia, muscle weakness, tunnel vision, tremor, numbness and tingling. Many of the effects were irreversible. Teratogenicity and foetal death also occurred.

Following from the observations of methylmercury poisonings there was speculation that foetal and infant development might be adversely affected within populations where thare is a high consumption of fish or other seafood. Two major longitudinal studies were established to monitor development for up to about 10 years of age. In the Seychelle Islands, where the food source was fish, no influence was detected. The source of food in the Faroe Islands was whale meat and irreversible impairment of certain brain functions were reported from this study

Various studies have suggested that chronic exposure to mercury may increase the incidence of hypertension and cardiovascular disease but negative results have also been reported.

Another controversial area has been the proposal that Thiomersal (ethylmercury) included in vaccines to prevent fungal and algal growth was responsible for the development of autism in children. No evidence to support this notion has been found but its use in infant vaccines has been phased out in many countries. The incidence of autism has since increased rather than decreased.

Laboratory Investigations

Traditionally, urine mercury has been quoted has the determination of choice when the suspected exposure is to elemental mercury or to inorganic mercury salts. However the stability of mercury in urine samples kept under other than optimum conditions is very poor, while blood samples are far more stable. Thus although urine mercury concentrations are widely used, especially for occupational monitoring, blood mercury is, possibly, the better indicator of exposure to elemental mercury or to inorganic mercury salts. In cases of exposure to organic mercury derivatives, measurement of blood mercury concentration is preferred.

References

1. Amin-Zaki L, Majeed MA, Clarkson TW, Greenwood MR. Methylmercury poisoning in Iraqi children: clinical observations over two years. BMJ 1978;1: 613-616
2. P Boffetta P et al. Mortality from cardiovascular diseases and exposure to inorganic mercury Occup Environ Med 2001;58:461-466.
3. Flaherty DK. The Vaccine-autism connection: A public health crisis caused by unethical medical practices and fraudulent science. Ann, Pharmacother 2011; 45: 1302-4.
4. Grandjean P. et al. Cardiac autonomic activity in methylmercury toxicity: 14-year follow-up of a Faroese birth cohort. J Pediatr 2004: 144: 169-76.
5. Houston MC. Role of mercury toxicity in hypertension, cardiovascular disease and stroke. J Clin Hyperten (Greenwich) 2011; 13: 621-7.
6. Taylor A and Marks V. Diagnostic value of urine mercury measurements. Annals of Clinical Biochemistry 1977; 14,: 297-300
7. UNEP/ILO/WHO. International Programme on Chemical Safety, Environmental Health Criteria 118 Inorganic Mercury. WHO, Geneva, 1991