

Overview

Useful For

Evaluation of central nervous system symptoms similar to Parkinson disease in manganese (Mn) miners and processors

Characterization of liver cirrhosis

Therapeutic monitoring in treatment of cirrhosis, parenteral nutrition-related Mn toxicity and environmental exposure to Mn

Evaluation of Behcet disease

Special Instructions

- [Trace Metals Analysis Specimen Collection and Transport](#)

Method Name

Dynamic Reaction Cell-Inductively Coupled Plasma-Mass Spectrometry (DRC-ICP-MS)

NY State Available

Yes

Specimen

Specimen Type

Whole blood

Specimen Required

Patient Preparation: High concentrations of gadolinium and iodine are known to interfere with most metals tests. If either gadolinium- or iodine-containing contrast media has been administered, a specimen should not be collected for 96 hours.

Supplies: Metal Free B-D Tube (EDTA), 6 mL (T183)

Container/Tube: Royal blue-top (EDTA) Vacutainer plastic trace element blood collection tube

Specimen Volume: 0.8 mL

Collection Instructions:

1. See [Trace Metals Analysis Specimen Collection and Transport](#) in Special Instructions for complete instructions.
2. Send specimen in original tube.

Additional Information: If ordering the trace element blood collection tube from BD, order catalog #368381 (Plastic K2EDTA 10.8 mg, royal blue-top).

Specimen Minimum Volume

0.2 mL

Reject Due To

Gross hemolysis	OK
Gross lipemia	OK
Gross icterus	OK

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Whole blood	Refrigerated (preferred)	28 days	
	Ambient	28 days	
	Frozen	28 days	

Clinical and Interpretive
Clinical Information

Manganese (Mn) is a trace essential element with many industrial uses. Mining and iron and steel production have been implicated as occupational sources of exposure. It is principally used in steel production to improve hardness, stiffness, and strength. Mn is a normal constituent of air, soil, water, and food. The primary non-occupational source of exposure is by eating food or Mn-containing nutritional supplements. Vegetarians who consume foods rich in Mn such as grains, beans, and nuts, as well as, heavy tea drinkers may have a higher intake than the average person. People who smoke tobacco or inhale second-hand smoke are also exposed to Mn at higher levels than non-smokers.

Inhalation is the primary source of entry for Mn, but is also partially absorbed (3%-5%) through the gastrointestinal tract. Only very small amounts of Mn are absorbed dermally. Signs of toxicity may appear quickly, and neurological symptoms are rarely reversible. Mn toxicity is generally recognized to progress through 3 stages. Levy describes these stages. "The first stage is a prodrome of malaise, somnolence, apathy, emotional lability, sexual dysfunction, weakness, lethargy, anorexia, and headaches. If there is continued exposure, progression to a second stage may occur, with psychological disturbances, including impaired memory and judgement, anxiety, and sometimes psychotic manifestations such as hallucinations. The third stage consists of progressive bradykinesia, dysarthric axial and extremity dystonia, paresis, gait disturbances, cogwheel rigidity, intention tremor, impaired coordination, and a mask-like face. Many of those affected may be permanently and completely disabled."⁽¹⁾ Mn is removed from the blood by the liver where it's conjugated with bile and excreted.

The major compartment for circulating Mn is the erythrocytes, bound to hemoglobin, with whole blood concentrations of Mn (in patients with normal levels) being 10 times that of the serum. Mn passes from the blood to the tissues quickly. Concentrations in the liver are highest, with 1 to 1.5 mg Mn/kg (wet weight) in normal individuals. The half-life of Mn in the body is about 40 days, with elimination primarily through the feces. Only small amounts are excreted in the urine.

Elevated levels of whole blood Mn have been reported, with and without central nervous system (CNS) symptoms, in patients with hepatitis B virus-induced liver cirrhosis, in patients on total parenteral nutrition (TPN) with Mn supplementation, and in infants born to mothers who were on TPN. The studies in cirrhotic patients with extrapyramidal symptoms indicate a possible correlation between whole blood Mn and that measured by T1-weighted magnetic resonance in the globus pallidus and midbrain, with whole blood Mn levels being 2-fold or

more, higher than normal. Increases in whole blood Mn over time may be indicative of future CNS effects. The data on TPN patients is based on anecdotes or small studies and is highly variable, as is that obtained in infants.(2)

Behcet disease, a form of chronic systemic vasculitis, has been reported to exhibit 4-fold increase in erythrocyte Mn and it is suggested that increased activity of superoxide dismutase may contribute to the pathogenesis of the disease.

Mn has also been reported as a contaminant in "garage" preparations of the abused drug methcathinone. Continued use of the drug gives rise to CNS toxicity typical of manganism.(3)

For monitoring therapy, whether of environmental exposure, TPN, or cirrhosis, whole blood levels have been shown to correlate well with neuropsychological improvement, although whether the laboratory changes precede the CNS or merely track with them is unclear as yet. It is recommended that both CNS functional testing and laboratory evaluation be used to monitor therapy of these patients. Long-term monitoring of Behcet disease has not been reported, and it is not known if the Mn levels respond to therapy.

Reference Values

4.7-18.3 ng/mL

Interpretation

Whole blood levels above the normal range are indicative of manganism (Mn). Values between 1 and 2 times the upper limit of normal may be due to differences in hematocrit and normal biological variation, and should be interpreted with caution before concluding that hypermanganesemia is contributing to the disease process. Values greater than twice the upper limit of normal correlate with disease. For longitudinal monitoring, sampling no more frequently than the half-life of the element (40 days) should be used.

Cautions

Whole blood manganese (Mn) concentrations are not responsive to dietary depletion, but measures of serum Mn are potentially useful.

Contamination of the collection site and of the specimen must be avoided. In the case of environmental evaluation, do not collect specimens in the workplace. Failure to use metal-free collection procedures and devices may cause falsely increased results. See Specimen Required and [Trace Metals Analysis Specimen Collection and Transport](#) in Special Instructions for collection and processing information.

Clinical Reference

1. Levy BS, Nassetta WJ: Neurologic effects of Manganese in humans: A review. *Int J Occup Environ Health* Apr/Jun 2003;9(2):153-163
2. Choi Y, Park J, Park N, et al: Whole blood and red blood cell manganese reflected signal intensities of T1-weighted magnetic resonance images better than plasma manganese in liver cirrhotics. *J Occup Health* 2005;47:68-73
3. Sanotsky Y, Lesyk R, Fedoryshyn L, et al: Manganic encephalopathy due to "Ephedrone" abuse. *Mov Disord* 2007;22:1337-1343
4. Jiang Y, Zheng W, Long L, et al: Brain magnetic resonance imaging and manganese concentrations in red blood cells of smelting workers: search for biomarkers of manganese exposure. *NeuroToxicology* 2007;28:126-135
5. Guilarte T, Chen M, McGlothlan J, et al: Nigrostriatal dopamine system dysfunction and subtle motor deficits in manganese-exposed non-human primates. *Exp Neurol* 2006;202:381-390

Performance

Method Description

Manganese (Mn) is analyzed using an inductively coupled plasma-mass spectrometer with universal cell technology (UCT) operated in dynamic reaction cell (DRC) mode. Aqueous acidic calibrating standards, reagent blanks, quality control specimen, and patient specimens are diluted with aqueous acidic diluent containing internal standard. In turn, the dilutions are aspirated by a pneumatic high-pressure nebulizer driven by argon gas. The nebulized solutions suspended in the carrier argon gas stream are injected into a high temperature (6800K) argon gas discharge (plasma). The plasma decomposes, atomizes, and ionizes the nebulized particles. All atoms, molecules, and ions formed in the discharge are extracted via a platinum orifice and enter the quadrapole ion deflector (QID) where only the ions are bent at a 90degree angle and pass into a quadrapole with UCT. The quadrapole cell is filled with ammonia (NH₃), which chemically reacts with the ion beam to remove polyatomic interferences and focus the beam into a quadrapole mass spectrometer. Mn ions are separated from the remaining concomitants by the quadrapole mass spectrometer allowing only Mn ions to collide with the instrument detector to produce a signal proportional to the bulk concentration of Mn in the sample and calculated by the instrument based upon a ratio with the internal standard gallium.(Unpublished Mayo method)

PDF Report

No

Day(s) and Time(s) Test Performed

Tuesday, Friday; 8 a.m.

Analytic Time

1 day

Maximum Laboratory Time

7 days

Specimen Retention Time

14 days

Performing Laboratory Location

Rochester

Fees and Codes

Fees

- Authorized users can sign in to [Test Prices](#) for detailed fee information.
- Clients without access to Test Prices can contact [Customer Service](#) 24 hours a day, seven days a week.
- Prospective clients should contact their Regional Manager. For assistance, contact [Customer Service](#).

Test Classification

This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. This test has not been cleared or approved by the U.S. Food and Drug Administration.

CPT Code Information

83785

LOINC® Information

Test ID	Test Order Name	Order LOINC Value
MNB	Manganese, B	5681-2

Result ID	Test Result Name	Result LOINC Value
89120	Manganese, B	5681-2