Heavy Metal Toxicity

Aluminum And Cadmium

Lead

Mercury

Heavy Metal Diagnostics

Clinical Application and Therapeutics

Cardiology
Neurology
Oncology
Nephrology
Immunology
A similar whole-body image study repeated in monkeys clearly demonstrated high levels of amalgam Hg in kidney, intestinal tract, and other tissues. The brain /CSF Hg ratio had increased threefold by week 4 after amalgam fillings had been installed.

• Mercury vapour, methyl mercury and ethyl mercury all target the central nervous system, kidneys and stomach.
• Chelators such as DMSA are effective in removing all forms of mercury from the body, but cannot reverse central nervous system damage.
• The allowable or safe intake of mercury has recently been reduced to 0.1 ugm/day per kg.
• Concentrations of Hg in the brain, blood and urine correlates with the # of amalgam fillings.
• Concentration increases with chewing by a factor of 10, nearing occupational safety limits.
• Association between mercury exposure and cardiovascular disease.

Behavioral Effects of Low-Level Exposure to Hg° Among Dentists


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Significant urinary Hg dose-effects were found for poor mental concentration, emotional lability, somatosensory irritation, and mood scores ... with deficits in digit span and simple reaction.

Human autopsy studies reveal significantly higher Hg concentrations in brain and kidney of subjects with aged amalgam fillings than in subjects who had no amalgam tooth restorations.

...urinary mercury was statistically and adversely associated with complex attention (switching task), the perceptual motor task (symbol-digit substitution), symptoms and mood.

It is concluded that accumulation of amalgam Hg progresses in maternal and fetal tissues to a steady state with advancing gestation and is maintained. Dental amalgam usage as a tooth restorative material in pregnant women and children should be reconsidered.

Heavy Metal Toxicity

Heavy Metals Signs And Symptoms

- Learning deficits
- Reduced intelligence
- Behavioral changes
- Cognitive changes
- Tremor
- Memory loss
- Fatigue
- Irritability
- Depression
- Multiple sclerosis
- Alzheimer's disease.

- Gingivitis Anemia
- Cancer
- Hypertension
- Headache
- Hyperuricemia
- Gout
- Chronic renal failure
- Male infertility
- Osteodystrophies
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Aluminum Toxicity

- Interferes with choline transport and acetylcholine, a characteristic of this disorder.
- Depletes phosphorus levels by forming insoluble aluminum phosphates in the GI tract.
- Produces negative effects on bone health and inhibiting normal catabolism of neuronal filaments in the CNS.
- Aluminum disturbs protein transcription and formation in the nucleus and ribosomes.
- Long-lived cells the most affected: neurotoxic and accumulates as we age.
- There is no effective detoxification process.
- Catalyzes free radical damage to nervous tissue.
Aluminum Toxicity

- Loss of balance
- Memory loss
- Incoordination
- Depression (MMPI)
- Seizures and dementia
Therapies For Aluminum Detoxification

- Stop all known sources of aluminum
- Calcium citrate 600 mg/day
- Zinc citrate 30 mg/day
- B6-250mg
- Vitamin C 5000 mg/day
- Lecithin 1000mg/day
- Antioxidants
- EDTA chelation therapy
Cadmium Toxicity

- Affects calcium, magnesium, sodium, potassium and zinc.
- Similar and antagonistic to zinc.
- Toxic to cardiovascular system: associated with heart attacks, stroke, hypertension and thrombosis.
- More toxic than lead or mercury.
- Accumulates in the kidneys, liver and blood.
- Linked to ADHD syndromes.
- Affects calcium metabolism and associated with musculoskeletal disorders.
- Produces anemia due to its interference with calcium, copper, manganese, zinc, selenium and iron.
Symptoms Of Cadmium Toxicity

- Fatigue
- Tissue aging
- Musculoskeletal pain
- Renal damage
- Anemia
- Hypertension
- Decreased appetite
- Sore joints
- Kidney damage

- Mouth lesions
- Dry scaly skin
- Hair loss
- Body weight loss
- Lung damage (emphysema)
- Zinc deficiency
- Reduction of iron, copper, manganese and calcium
- Decreased growth
Treatment of Cadmium Toxicity

- Avoid cadmium exposure
- Vitamin C - 5 gms per day
- Complete mineral supplementation program including calcium citrate 600 mg/day, zinc picolinate 30 mg/day, and magnesium citrate 300 mg/day.
- Low dietary intakes of calcium can lead to increased absorption of cadmium.
- Consider EDTA chelation therapy
Heavy Metal Toxicity

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Children exposed to toxic amounts of lead are subject to several behavioral disorders resulting from damage to the central nervous system.

"The frequency of non-adaptive classroom behavior increased in a dose-related fashion to dentine lead levels. Lead exposure, at doses below those producing symptoms severe enough to be diagnosed clinically, appears to be associated with neuropsychologic deficits that may interfere with classroom performance."

Needleman HL et al. Deficits in psychologic and classroom performance of children with elevated dentine lead levels. NEJM; 300(13): 689-693, 1979
THE HEALTH EFFECTS OF LOW LEVEL EXPOSURE TO LEAD

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Neuropediatrics Unit, Children’s Hospital and Harvard Medical School, Boston, Massachusetts 02115

KEY WORDS: lead poisoning, child development, environmental health, neurotoxicology

INTRODUCTION

Eight years ago, the problem of low level lead exposure in children was reviewed in the Annual Review of Public Health (65). (The term “low level” refers to exposure that is below those at which clinical signs of lead poisoning are apparent.) Since that time, knowledge about lead’s health effects, chemical toxicology, and sources and routes to people has grown exponentially. Real progress in lowering environmental levels of lead has been achieved, notably through the virtual ban on leaded gasoline. In some cases, particularly housing, efforts to abate lead have failed completely. But, despite increased recognition of the widespread distribution of lead, islands of ignorance about its effects at low dose persist. Many modern pediatric textbooks contain discussions of the diagnosis and treatment of frank lead poisoning, but do not mention effects of lead at lesser dose.

In this review, we examine some of the newer biomedical and epidemiological information about lead at low dose and evaluate the recent studies. We then suggest some policy actions to redress the imbalance between the best knowledge of lead’s dangers and the limited steps to eliminate them.


“...despite increased recognition of the widespread distribution of lead, islands of ignorance about its effects at low dose persist......Lead poisoning is a low technology disease. It does not posses the drama of transplant surgery or molecular biology. ...as a result they do not think of the disease when constructing a differential diagnosis of developmental delay, growth failure or behavior disorder.”
Lead Toxicity And Cell Function

- Impaired synthesis of RNA, DNA and protein
- Impaired metabolism of vitamin D
- Uricemia
- Hyperaminoaciduria
- Glycosuria and phosphaturia.

- Impaired heme synthesis
- Inhibition of erythrocyte Na, K ATPase
- Diminished RBC glutathione
- Shortened RBC life span
Signs and Symptoms of Lead Toxicity

- Cavities in children
- Constipation
- Poor appetite
- Abdominal pain
- Atherosclerosis
- Hypertension
- Metallic taste
- Anemia
- Kidney disease
- Joint pains
- Porphyrias

- Decreased nerve conduction
- Peripheral neuropathy
- Demyelination
- Attention deficit disorder
- Numbness in the fingers, toes, and lips
- Tremors
- Learning disorders
- Headache
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Immunology
University of Tubingen, Germany
Study Of 17,500 Patients

Symptoms and mercury concentration in saliva.

• **Mouth/Oral Cavity** – bleeding gingiva, metal taste, burning tongue
• **Central Nervous system** – Concentration difficulties, impaired memory, sleep disturbances, lack of initiative, nervousness.
• **Gastrointestinal tract**: unspecified symptoms
Mercury is a cellular toxin. Mercury causes several harmful actions:

1] Mercury is a pro oxidant
2] Mercury interferes with antioxidant enzymes (SOD, catalase, GSH peroxidase)
3] Mercury binds to sulfhydryl groups (glutathione)
"Subjects with 12 or more occlusal amalgam surfaces were estimated to receive a daily Hg dose of 29 micrograms, whereas in subjects with four or fewer occlusal amalgam surfaces, the dose was 8 micrograms. These Hg dosages from dental amalgam were as much as 18-fold the allowable daily limits established by some countries for Hg exposure from all sources in the environment. The results demonstrate that the amount of elemental Hg released from dental amalgam exceeds or comprises a major percentage of internationally accepted threshold limit values for environmental Hg exposure. It is concluded that dental amalgam Hg makes a major contribution to total daily dose."

Neurological Symptoms Of Mercury Toxicity

- Decreased sense of touch, hearing, vision, taste
- Numbness of fingers, toes, lips
- Salivation
- Tremor
- Spasms of muscles
- Speech impairment
- Emotional disturbances
- Excitability
- Parasthesias (organic mercury)
Signs And Symptoms Of Mercury Toxicity

- Diminished sensing
- Excitability
- Numbness of fingers, toes, and lips
- Salivation
- Tremor
- Spasticity
- Speech impairment
- Emotional disturbances
- Parasthesias

- Anorexia
- Nephrotic syndrome
- Still births
- Spontaneous abortions
- Congenital malformations
- Decreased sperm production
- Chromosomal defects
- Impotency
- Menstrual disturbances
Diseases From Mercury Toxicity

Lichen planus
Cataracts
Endocrine dysfunction
Glomerulonephritis
Autoimmune disease
MS

Porphyrias
Headaches
Dementias
Neurological diseases
Kidney diseases
Essential hypertension
The possibility of amalgam Hg-induced renal dysfunction should be considered.

Lab Risk Evaluation

- Hair elements
- Urine elements
- Fecal toxic metals
- Creatinine
- Essential elements (whole blood)
- Urine amino acids
- GI function
Hair Analysis

Hair mercury concentrations greater than 5ppm are indicative of mercury intoxication.

Other minerals which are disturbed:
- Calcium
- Magnesium
- Manganese
- Zinc

Sodium 2,3-Dimercaptopropane-1-Sulfonate Challenge Test for Mercury in Humans: II. Urinary Mercury, Porphyrins and Neurobehavioral Changes of Dental Workers in Monterrey, Mexico

Diego Gonzalez-Ramirez, Richard M. Maclino, Miguel Zanga-Charles, Zhang Xu, Katherine M. Hultet, Pablo Juquin-Nunez, Mary M. Aposhan, Richard A. Dart, Jose Horacio Diaz-Gama, Diana Ech-Cherrier, James E. Woods and Vasili J. Aposhan

Department of Pharmacology, Centro de Investigacion Biomedica Del Noreste, Instituto Mexicano del Seguro Social, Monterrey, Mexico.

The urinary mercury after DMPS administration is a better indicator of exposure and renal mercury burden than is mercury level measured before DMPS is given.

<table>
<thead>
<tr>
<th>METALS</th>
<th>RESULT μg/g CREAT</th>
<th>REFERENCE RANGE</th>
<th>WITHIN REFERENCE RANGE</th>
<th>ELEVATED</th>
<th>VERY ELEVATED</th>
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<tbody>
<tr>
<td>Aluminum</td>
<td>&lt; dl</td>
<td>&lt; 35</td>
<td></td>
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<tr>
<td>Antimony</td>
<td>0.4</td>
<td>&lt; 5</td>
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<td>Arsenic</td>
<td>52</td>
<td>&lt; 100</td>
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<td></td>
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</tr>
<tr>
<td>Beryllium</td>
<td>&lt; dl</td>
<td>&lt; 0.5</td>
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</tr>
<tr>
<td>Bismuth</td>
<td>0.8</td>
<td>&lt; 30</td>
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</tr>
<tr>
<td>Cadmium</td>
<td>3.6</td>
<td>&lt; 2</td>
<td></td>
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<tr>
<td>Lead</td>
<td>7.1</td>
<td>&lt; 15</td>
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</tr>
<tr>
<td>Mercury</td>
<td>45</td>
<td>&lt; 3</td>
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</tr>
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<td>8.2</td>
<td>&lt; 12</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Platinum</td>
<td>&lt; dl</td>
<td>&lt; 2</td>
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</tr>
<tr>
<td>Thallium</td>
<td>0.3</td>
<td>&lt; 14</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Thorium</td>
<td>&lt; dl</td>
<td>&lt; 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tin</td>
<td>0.7</td>
<td>&lt; 6</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Tungsten</td>
<td>0.3</td>
<td>&lt; 23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uranium</td>
<td>0.1</td>
<td>&lt; 1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
IV EDTA Challenge

- 3 gm of EDTA IV over 3 hrs
- Encourage 0.5-1.0 L fluid over next few hrs.
- Collect all urine for 24 hrs.
- For lead, cadmium, aluminum assessment
The predictors of lead excretion after DMSA and EDTA are different and an earlier dose of EDTA may increase lead excretion after subsequent dose of DMSA. The results suggest that a two hour or four hour cumulative lead excretion after DMSA may provide an estimate of lead storage sites that are most directly relevant to the health effects of lead.

Figure 3. Ability of Chelating Agents to Lower Mercury Content of Renal Tissue in vitro from Rabbits Injected with Mercuric Chloride
2,3-dimercapto-1-propane-sulfonate

CH$_2$-CH$_2$-CH$_2$-SO$_3^-$ Na$^+$

SH      SH

Intravenous DMPS is superior for provocation challenges.
Effective for mercury, methyl mercury, silver, copper, lead, nicle, arsenic, zinc, cadmium
When the DMPS-Hg challenge test was used to study dental personnel occupationally exposed to Hg, the urinary excretion of Hg was 88, 49 and 35 times greater after DMPS administration in 10 dental technicians.
Heavy Metal Diagnostics

Mobilization of Mercury and Arsenic in Humans by Sodium 2,3-Dimercapto-1-propane Sulphonate (DMPS)

H. Vesken Aposhian

Department of Molecular and Cellular Biology, Department of Pharmacology, The University of Arizona, Tucson, Arizona.

Sodium 2,3-dimercapto-1-propane sulfonate (DMPS, Dimaval) is a water-soluble compound that can be given by mouth or systemically and has been used to treat mercury poisoning in the former Soviet Union and since 1979 in Germany. To better understand the mechanisms of Hg and As mobilization in humans, DMPS-Hg and DMPS-As challenge tests were performed. The tests involved instilling an overnight saline, administering 500 mg of DMPS intravenously, followed by the same saline solution the next day, and determining the urinary Hg before and after the challenge. The challenge test was used to assess its feasibility for occupational exposure to Hg. The urinary elimination of Hg was 80, 49, and 18% for occupational exposure to Hg. DMPS administration 10 days before administration of DMPS also accounted for the results. DMPS also was used to measure the degree of mercury excretion in a single dose intravenous challenge test with a sodium-cysteine solution containing 500 mg HgAs. The hypothesis is presented that a long-term exposure to Hg may have led to the development of symptoms of mercury intoxication. Aposhian HV. Mobilization of mercury and arsenic in humans by sodium 2,3-dimercapto-1-propane sulfonate (DMPS). Environ Health Perspect;106(Suppl 4):1017-1025, 1998.
"Since the development in the 1940’s of chelating agents for therapeutic use in metal and metalloid poisonings, DMPS and DMSA have been the most selective and specific. Of these two orally useful chelating agents, DMPS has three advantages. First it appears to remain in the body for a longer time than DMSA. Second, it acts more quickly than DMSA, probably because of its distribution is both extracellular and intracellular. DMSA, however, appears to be only extracellular in distribution. Third, preparations of DMPS are available for intravenous and intramuscular use."

Oral DMPS Challenge

- 10 mg DMPS/kg BW as oral bolus on empty stomach (empty bladder)
- With hold food about 2 hrs.
- Encourage 0.5-1.0 L fluid over next few hrs.
- Collect all urine for 6 hrs.
- Oral yield about 40% less than iv (3-5 mg/kg)


DDI observations
# Heavy Metal Diagnostics

## FECAL METALS

**LAB#:**
**PATIENT: S #1**
**SEX: Male**
**AGE: 51**

## POTENTIALLY TOXIC METALS

<table>
<thead>
<tr>
<th>METALS</th>
<th>RESULT mg/kg</th>
<th>REFERENCE RANGE</th>
<th>68&lt;sup&gt;th&lt;/sup&gt;</th>
<th>95&lt;sup&gt;th&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>0.182</td>
<td>&lt;.05 w/o amalgams*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td>0.182</td>
<td>&lt;.5 with amalgams*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimony</td>
<td>0.177</td>
<td>&lt; 0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.38</td>
<td>&lt; 0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beryllium</td>
<td>0.010</td>
<td>&lt; 0.009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bismuth</td>
<td>0.082</td>
<td>&lt; 0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.53</td>
<td>&lt; 0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>35</td>
<td>&lt; 60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>0.52</td>
<td>&lt; 0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td>4.0</td>
<td>&lt; 8.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platinum</td>
<td>&lt; dl</td>
<td>&lt; 0.003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thallium</td>
<td>0.010</td>
<td>&lt; 0.02</td>
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<tr>
<td>Tungsten</td>
<td>4.004</td>
<td>&lt; 0.09</td>
<td></td>
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</tr>
<tr>
<td>Uranium</td>
<td>0.080</td>
<td>&lt; 0.12</td>
<td></td>
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</tr>
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</table>

## % WATER CONTENT

<table>
<thead>
<tr>
<th>% WATER CONTENT</th>
<th>RESULT % H₂O</th>
<th>EXPECTED RANGE</th>
<th>2SD LOW</th>
<th>1SD LOW</th>
<th>MEAN</th>
<th>1SD HIGH</th>
<th>2SD HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>% WATER CONTENT</td>
<td>84.5</td>
<td>60-85%</td>
<td>72.5%</td>
<td>1SD HIGH</td>
<td>2SD HIGH</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fecal Toxic Metals

- > 90% of Hg is naturally excreted via the biliary (fecal) route
- Fecal Hg correlated with amalgams (exposure)
- No pharmaceutical provocation agent required
- Special applications test
  - Infants and children, autistics
  - Chemically sensitive patients
  - Renal Insufficiency
Heavy Metal Diagnostics

The graph shows the level of heavy metals in different categories:

- **None**: 0.038
- **1 to 3**: 0.074
- **4 to 7**: 0.315
- **8 to 12**: 0.644

The graph indicates a significant increase in heavy metal levels from category to category, with the highest level (0.644) found in the 8 to 12 category.
DMSA

Meso-2,3-dimercaptosuccinic acid

H H
HOOC-C-C-COOH
SH SH

Water-soluble, sulfhydryl-containing compound
Crosses blood brain barrier
Effective for mercury, methyl mercury, silver, copper, lead,
High Dose DMSA Challenge

- **30 mg** DMSA/kg BW as oral bolus on empty stomach (empty bladder)
- With hold food about 2 hrs.
- Encourage 0.5-1.0 L fluid over next few hrs.
- Collect **all** urine for 6 hrs.

### DMSA Challenge Dosage: 7 yo Autistic Male

- **10 mg/kg**
- **30 mg/kg**

(µg/gram creatinine)

<table>
<thead>
<tr>
<th></th>
<th>10 mg/kg</th>
<th>30 mg/kg</th>
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</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>Lead</td>
<td>42</td>
<td>100</td>
</tr>
<tr>
<td>Mercury</td>
<td>&lt;dl</td>
<td>&lt;dl</td>
</tr>
</tbody>
</table>

Quig and Tenpenny, 2002
Heme metabolism is affected by mercury

Porphydrins can be measured

Mercury exposure creates a "fingerprint"

Mercury allergy can create common symptoms:
• Urticaria
• Lichen Planus
• Allergies

“The results show that patients with OLP have significantly higher lymphocyte reactivity to inorganic mercury.”

Mercury allergy can create common symptoms:

• Urticaria
• Lichen Planus
• Allergies

“The results show that patients with OLP have significantly higher lymphocyte reactivity to inorganic mercury.”

Paul

Initial Intake
03/10/00

AGE: 61

OCCUPATION: Computer consulting

PRESENTING PROBLEM:

Frustrated and fearful person, gets stress symptoms

- Back pain
- Got into a bad investment situation.
- Tries to do everything to excess, likes to go fast.
- At one point in 1995 was burning out, took a 6 mos leave of absence, became hypothermic, weight dropped for 145 - 126, went to MD and put him on Paxil, weight came back, muscle pains were better, then stopped medication after 1 year, then flared, took it again because feeling anxious.

- High blood pressure, 135/94... borderline, when first started teaching was rejected because had a 130/90 BP, this was 20 years ago, no life insurance, MD told him he has ideopathic hypertension.

- Began to have serious problems at night, high pulse rate, finally came to the point had pains in L shoulder, had tendonitis, in L arm, one night had a bad night with chest pain, has had night time anxiety pains, this came on, a gripping kind of chest pain.
In 13 patients with IDCM, mean mercury concentration was 22,000 times, antimony 12,000 times, gold 11 times, chromium 13 times, and cobalt 4 times higher than in controls.

Trace elements may affect mitochondrial activity and myocardial metabolism and worsen cellular function.

**HEMATOLOGY**

<table>
<thead>
<tr>
<th>Test</th>
<th>Out of Range</th>
<th>Within Range</th>
<th>Reference Range and Comments</th>
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<tr>
<td>WBC</td>
<td>✓ 4.2</td>
<td>4.0-10.0</td>
<td>giga/L</td>
</tr>
<tr>
<td>RBC</td>
<td>4.94</td>
<td>4.20-5.40</td>
<td>tera/L</td>
</tr>
<tr>
<td>HEMOGLOBIN</td>
<td>✓ 157</td>
<td>133-165</td>
<td>g/L</td>
</tr>
<tr>
<td>HEMATOCRIT</td>
<td>0.44</td>
<td>0.38-0.50</td>
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<td>MCV</td>
<td>90</td>
<td>82-98</td>
<td>fl</td>
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<tr>
<td>MCH</td>
<td>31.8</td>
<td>27.5-33.5</td>
<td>pg</td>
</tr>
<tr>
<td>MCHC</td>
<td>✓ 1.9</td>
<td>2.0-7.0</td>
<td>giga/L</td>
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<tr>
<td>NEUTROPHILS</td>
<td></td>
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<tr>
<td>LYMPHOCYTES</td>
<td>1.6</td>
<td>1.0-3.0</td>
<td>giga/L</td>
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<td>MONOCYTES</td>
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<td>GLUCOSE RANDOM</td>
<td>✓ 4.9</td>
<td>&lt;11.1</td>
<td>mmol/L</td>
</tr>
<tr>
<td>LAST AT EAT</td>
<td>0900</td>
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<td></td>
</tr>
<tr>
<td>TIME SINCE EATING</td>
<td>1.83</td>
<td>hrs</td>
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<tr>
<td>CREATININE</td>
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<td>70-120</td>
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</tr>
<tr>
<td>GGT</td>
<td>✓ 17</td>
<td>10-65</td>
<td>U/L</td>
</tr>
</tbody>
</table>

**REFFERED TESTS**

ECG  
Forwarded to Western Cardiology for interpretation. Phone 595-1551.

**RESULTS TO FOLLOW:**

PROSTATE SPECIFIC ANTIGEN

0.67 ng/mL (0-4.5 ng/mL)
### Elemental Analysis Hair

**Patient:**

**ID:** 033100-0641  **Age:** 61  **Sex:** Male

**Collected:** 3/29/00  **Received:** 3/31/00  **Completed:** 4/4/00

#### Toxic Elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Patient Results (ppm)</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>1.7</td>
<td>0.9 - 9</td>
</tr>
<tr>
<td>Antimony</td>
<td>0.026</td>
<td>0.003 - 0.03</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.033</td>
<td>0.01 - 0.1</td>
</tr>
<tr>
<td>Barium</td>
<td>1.04</td>
<td>0.1 - 1.1</td>
</tr>
<tr>
<td>Bleomycin</td>
<td>0.0018</td>
<td>0 - 0.11</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.047</td>
<td>0 - 0.10</td>
</tr>
<tr>
<td>Lead</td>
<td>1.49</td>
<td>0 - 1.4</td>
</tr>
<tr>
<td>Mercury</td>
<td>4.66</td>
<td>0 - 1</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.310</td>
<td>0 - 0.4</td>
</tr>
<tr>
<td>Thallium</td>
<td>0.001</td>
<td>0 - 0.001</td>
</tr>
<tr>
<td>Tin</td>
<td>0.012</td>
<td>0 - 0.006</td>
</tr>
<tr>
<td>Uranium</td>
<td>0.001</td>
<td>0 - 0.006</td>
</tr>
</tbody>
</table>

#### Nutrient Elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Patient Results (ppm)</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>973</td>
<td>246 - 960</td>
</tr>
<tr>
<td>Magnesium</td>
<td>52.72</td>
<td>24 - 60</td>
</tr>
<tr>
<td>Copper</td>
<td>63</td>
<td>15.6 - 38</td>
</tr>
<tr>
<td>Zinc</td>
<td>136</td>
<td>123 - 170</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.42</td>
<td>0.06 - 0.4</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.30</td>
<td>0.2 - 0.72</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.012</td>
<td>0.000 - 0.05</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>0.064</td>
<td>0.03 - 0.006</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.74</td>
<td>0.35 - 2.5</td>
</tr>
<tr>
<td>Lithium</td>
<td>0.0042</td>
<td>0.0056 - 0.006</td>
</tr>
<tr>
<td>Rubidium</td>
<td>0.021</td>
<td>0.0056 - 0.01</td>
</tr>
<tr>
<td>Strontium</td>
<td>2.3</td>
<td>0.01 - 1.7</td>
</tr>
<tr>
<td>Sulfur</td>
<td>4.0928</td>
<td>0.1 - 3.25</td>
</tr>
</tbody>
</table>

#### Additional Elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Patient Results (ppm)</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>159</td>
<td>85 - 850</td>
</tr>
<tr>
<td>Potassium</td>
<td>44.2</td>
<td>4.4 - 30</td>
</tr>
<tr>
<td>Iron</td>
<td>3.3</td>
<td>6 - 18</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>192</td>
<td>30 - 190</td>
</tr>
<tr>
<td>Titanium</td>
<td>0.63</td>
<td>0.25 - 2.25</td>
</tr>
</tbody>
</table>

**Ratio**

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Patient results</th>
<th>Expected range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca/Mg</td>
<td>18.5 H</td>
<td>5.0 - 15.0</td>
</tr>
<tr>
<td>Ca/P</td>
<td>7.4 H</td>
<td>2.6 - 7.0</td>
</tr>
<tr>
<td>Na/K</td>
<td>3.1 1.5 - 4.0</td>
<td></td>
</tr>
</tbody>
</table>

*External contamination, including shampoo and other hair treatments, can result in false elevation of certain elements. The likelihood of this interference is reflected in the amount of color within each circle. Less color correlates with a higher degree of contamination probability.*
Elemental Analysis Hair

Patient: [Redacted]
ID: 033100-0641  Age: 61  Sex: Male

Collected: 3/29/00  Received: 3/31/00  Completed: 4/4/00

<table>
<thead>
<tr>
<th>Toxic Elements</th>
<th>Nutrient Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sodium</strong></td>
<td>120 ppm</td>
</tr>
<tr>
<td><strong>Potassium</strong></td>
<td>44.2 ppm</td>
</tr>
<tr>
<td><strong>Iron</strong></td>
<td>3.3 ppm</td>
</tr>
<tr>
<td><strong>Phosphorus</strong></td>
<td>192 ppm</td>
</tr>
<tr>
<td><strong>Titanium</strong></td>
<td>0.63 ppm</td>
</tr>
</tbody>
</table>

| Calcium | 973 ppm |
| Magnesium | 52.72 ppm |
| Copper | 0.012 ppm |
| Manganese | 0.042 ppm |
| Cobalt | 0.012 ppm |
| Molybdenum | 0.004 ppm |
| Aluminum | 1.7 ppm |
| Antimony | 0.028 ppm |
| Arsenic | 0.33 ppm |
| Barium | 1.04 ppm |
| Blurruth | 0.0018 ppm |
| Cadmium | 0.047 ppm |
| Lead | 1.49 ppm |
| Mercury | 4.66 ppm |
| Nickel | 0.310 ppm |
| Thallium | 0.0001 ppm |
| Tn | 0.012 ppm |
| Uranium | 0.0011 ppm |
| **Reference** | **Borderline** | **High** |

<table>
<thead>
<tr>
<th><strong>Reference Range</strong></th>
<th><strong>Patient Result</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur</td>
<td>400 ppm</td>
</tr>
<tr>
<td>Vanadium</td>
<td>0.077 ppm</td>
</tr>
<tr>
<td><strong>Ratio</strong></td>
<td><strong>Patient Result</strong></td>
</tr>
<tr>
<td>Ca/Mg</td>
<td>18.5</td>
</tr>
<tr>
<td>Ca/P</td>
<td>7.4</td>
</tr>
<tr>
<td>Na/K</td>
<td>3.1</td>
</tr>
</tbody>
</table>

External contamination, including shampoos and other hair treatments, can result in false elevation of certain elements. The likelihood of this interference is reflected in the amount of color within each circle. Less color correlates with a higher degree of contamination probability.
<table>
<thead>
<tr>
<th>TEST</th>
<th>RANGE</th>
<th>UNITS/L</th>
<th>REFERENCE RANGE AND COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHEAS</td>
<td>0.3 - 12.3</td>
<td>umol/L</td>
<td>Prepubertal: &lt;1.5 umol/L</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Adult male: 4 - 11 umol/L</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;50 years: 1 - 6.5 umol/L</td>
</tr>
<tr>
<td>BLOOD LEAD</td>
<td>0.07 - 1.93</td>
<td>umol/L</td>
<td></td>
</tr>
<tr>
<td>BLOOD MERCURY</td>
<td>6 - 65</td>
<td>nmol/L</td>
<td>0 - 49 umol/L</td>
</tr>
</tbody>
</table>
Clinical Application and Therapeutics

### Urine Mercury

<table>
<thead>
<tr>
<th>Elements</th>
<th>Per gram Creatinine</th>
<th>Reference Range (ug/mmol)</th>
<th>Result (ug/mmol)</th>
<th>Per 24-hour creatinine</th>
<th>Reference Range (ug/day)</th>
<th>Within Ref. Range</th>
<th>Very Elevated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>8.6</td>
<td>0 - 3</td>
<td>13</td>
<td></td>
<td>0 - 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Discussion**

This individual’s urine mercury equals or exceeds twice the maximum expected level. Presentation of symptoms associated with excessive mercury can depend on many factors: the chemical form of absorbed Hg and its transport in body tissues, presence of other synergistic toxins (Pb, Cd have such effects), presence of disease that depletes or sequesters mercury, or is immunosuppressive, organ levels of xenobiotic chemicals and sulfhydryl-bearing metabolites (e.g. sulfocyanate), and the concentration of protective nutrients (e.g. zinc, selenium, vitamin D).

Early signs of mercury contamination include decreased sense of touch, hearing, vision and taste, metallic taste in mouth, fatigue or lack of physical endurance, and increased salivation. Symptoms may progress with moderate or chronic exposure to include: anorexia, numbness and paresthesias, headaches, hypertension, irritability and excitability, and immune suppression, possibly immune dysregulation. Advanced disease processes from mercury toxicity include: tremors and incoordination, anxiety, psychoses, manic behaviors, possibly autoimmune disorders, renal dysfunction or failure.

Mercury is commonly used in dental amalgams, plastic adhesives, in pure liquid form for thermometers, barometers, and laboratory equipment, batteries and electronics (“cathodic”); and in fungicides and pesticides. The fungicide/pesticide use of mercury has declined due to environmental concerns, but mercury residues persist from past use.

Methylmercury, the common, poisonous form, occurs by methylation in aquatic biota or sediments (both freshwater and ocean sediments). Methylmercury accumulates in aquatic animals and fish and is concentrated up the food chain reaching high concentrations in large fish and predatory birds. Except for fish, the human intake of dietary mercury is negligible unless the food is contaminated with one of the previously listed sources. A daily diet of fish can cause 1 to 10 micrograms of mercury/day to be ingested, with about three-quarters of this (typically) as methylmercury.

**References**


**Other Tests**

<table>
<thead>
<tr>
<th>Element</th>
<th>Result (mg/day)</th>
<th>Reference Range (mg/day)</th>
<th>2SD Low</th>
<th>1SD Low</th>
<th>Mean</th>
<th>1SD High</th>
<th>2SD High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>1.57</td>
<td>1.1 - 2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Methodology:** Analyzed by Induction Coupled Plasma Mass Spectrometry (ICP-MS). Creatinine by Jaffe method.

**Comments:** (Post provocative challenge.) High 24 hour volume.

“DL” = detection limit
*No safe level established.*
Who Should Have Amalgams Removed?

- Immune disorders
- Cancer
- Neurological diseases
- Musculoskeletal disorders
- Renal diseases
- Cardiovascular disorders
10 Steps To Mercury Free Health

1] Evaluation
2] Testing
3] Pick A Dentist
4] Pre-removal treatment program
5] Mercury Removal
6] Post Removal Detox Program
7] Re-evaluation at 3 months
8] Retest at 6 months
9] Start a 1 year program
10] One year retesting and follow-up
Dental Office Protocol

1. Make sure the dentist keeps the fillings cool.
2. Check to see if there is a high volume evacuator.
3. Ask if there is an alternative air source.
4. Check to see if the dental assistants immediately dispose of the mercury alloy.
5. Request that the amalgam is removed in large chunks.
6. After the removal, the mouth should be thoroughly checked and rinsed of any residual particles.
7. Check to see if there is air purification in the office.
8. Remember to use pre and post op nutritional support.
**Pre-removal Treatment**

<table>
<thead>
<tr>
<th>Category</th>
<th>Supplement</th>
<th>Dosage and Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROTEIN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FATS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CARBOHYDRATES</td>
<td>Lactobacillus</td>
<td>15-20 billion organisms/day</td>
</tr>
<tr>
<td></td>
<td>Milk Thistle</td>
<td>150mg twice daily</td>
</tr>
<tr>
<td></td>
<td>Lipoic Acid</td>
<td>50 milligrams twice daily</td>
</tr>
<tr>
<td></td>
<td>Vitamin C</td>
<td>4-20 gms/day</td>
</tr>
<tr>
<td></td>
<td>Taurine</td>
<td>500 mg three times per day between meals</td>
</tr>
<tr>
<td></td>
<td>Curcumin</td>
<td>1 cap three times a day</td>
</tr>
<tr>
<td></td>
<td>Magnesium</td>
<td>300 mg twice a day</td>
</tr>
<tr>
<td></td>
<td>Zinc</td>
<td>30mg/day</td>
</tr>
</tbody>
</table>
Results showed that mercury released from dental amalgam can enhance the prevalence of resistance to multiple antibiotics in the bacteria of the primate normal flora.

During Amalgam Removal

Intravenous vitamin C after each amalgam removal.
ProAlgin: 1 pill three times a day
Trace Minerals: 1 pill twice a day
Calcium/Magnesium Citrate: 300 mg twice a day
NAC: 1000mg twice a day between meals
Intravenous Vitamin C

- Pioneered by Dr. Fredrick Klenner
- Effective in mercurial poisoning
- Protects detoxification enzymes
- Neutralizes a wide variety of bacterial toxins
- Neutralizes and detoxifies chemicals and drugs: strychnine, snake bite venoms and benzene
- If guinea pigs are poisoned by mercuric chloride, 40% survived with IV vitamin C
- In cases of stress, inflammation and infection humans need up to 35 gms/day.
After Amalgam Removal

**DMPS**
250mg IV once a month

**Or**

**DMSA**
500mg three times a day for 3 days/month

**Saunas**
Twice a week for 6 weeks

**Intravenous Nutrient Therapy**
Once a week for 3-6 weeks
For elemental mercury, inorganic mercury and organic mercury, DMPS is superior to DMSA. For lead, DMSA is the first choice.

The data suggest that DMSA and EDTA lead excretion correlated; that lead excretion after EDTA was generally higher than after DMSA; that peak urinary lead concentrations and return to baseline are attained more rapidly after DMSA than after EDTA; and that lead excretion after DMSA is rapid.

Metal Detoxification : DMPS

- **Oral**: No well established protocols. ≈ 100-200 mg tid, 2-5 days on, about 1.5 weeks off
- Check metal excretion (urine) and elemental status (RBC, WBC) after ~5 treatments (Zn, Cu, Mo, Mg)
- Oral vitamin/mineral supplementation on “off days”; iv if necessary
- **IV**: 3-5 mg/kg slow push, @ 2-4 week intervals
Alabama Lipoic Acid

“Lipoic acid has been shown, by its increasing of cellular glutathione levels, to support the mobilization and excretion of mercury, and to decrease cellular damage and neurotoxicity.”

Glutathione (GSH)

Reducing/conjugating agent
90% is in the cell cytosol, rest is in mitochondria.
Small decreases in mitochondrial GSH results in cell death.
Mercury preferentially targets mitochondria and GSH depletion
MAJOR FUNCTIONS OF GLUTATHIONE

- Protects cells against the destructive effects of reactive oxygen intermediates and free radicals
- Detoxifies substances such as drugs and environmental pollutants
- Maintains cell membrane stability
- Regulates protein and DNA biosynthesis and cell growth
- Enhances immunologic function through its effects on lymphocytes.
Study participants who were diagnosed with heart disease, diabetes, high blood pressure, circulation problems, stomach symptoms and urinary tract infections had low glutathione.

The group of very old people (age 80 to 95) had very high blood levels of glutathione and were diagnosed by physicians as well as in their own self-reports as super healthy.

Glutathione Enhancing Foods Protect Mitochondria

- Cruciferous vegetables
- Fresh fruits
- Pine bark extract (pycnogenol)
- Whey
- Milk thistle
- Bilberry
- Grape extract
- Turmeric
Clinical Points About Detoxification Of Mercury

1] Do NOT co-administer glutathione, cysteine, garlic or NAC with dithiol agents
2] Stop all mineral supplements 24 hours prior to and after dithiol agents
3] Monitor essential element status and supplement
4] Consume plenty of water
5] Use a sauna
After Amalgam Removal

- Re-evaluation at 3 months
- Retest at 6 months
- Start a 1 year program
- One year re-testing and follow-up