



It's Not Your Father's Music: Toxicology of Heavy Metals

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- Relevant Financial Relationships:
 - None
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 - None

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Objectives

- After this session, the participant will be able to:
 1. Recognize and correlate the physical, clinical laboratory, and anatomic findings related to the following heavy metal exposures/toxicities:
 1. Arsenic
 2. Lead
 3. Mercury
 2. Identify the appropriate specimen which should be used to detect exposure to each of the metals listed above
 3. Correctly interpret the heavy metal test results and suggest appropriate follow-up testing
 4. Summarize the mechanism of toxicity for the metals listed above
 5. List the appropriate treatment/management for heavy metal toxicities

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Why Should People Think About Metals?

Lipsticks, glosses contain toxic metals

Updated: May 2, 2013 09:59 AM EDT



HealthDay/TV

By Kathleen Doherty
HealthDay Reporter

THURSDAY, May 2 (HealthDay News) — Lipsticks and lip glosses apparently give you more than vibrant colors, according to a new study by California scientists that contends the products contain lead, cadmium, chromium, aluminum and five other toxic metals.

<http://www.foxdetroit.com/story/22140893/lipsticks-glosses-contain-toxic-metals-report>

CDC Home Search Health Topics A-Z

MMWR


Dispatch

March 22, 2008 / 57(12week3):1-2

Death of a Child After Ingestion of a Metallic Charm --- Minnesota, 2006


Lead-based paint remains the most common source of lead exposure for children aged $0-6$ years. However, one report determined that 34% of children aged $0-6$ years with lead poisoning in Las Vegas County had been exposed to items containing lead that had been brought into the home (1). These items might include candy, folk and traditional medications, ceramic dinnerware, and metallic toys and trinkets. Exposure to some of these items can result in life-threatening BLLs of 2100 $\mu\text{g}/\text{dL}</math> (elevated BLLs are 210 $\mu\text{g}/\text{dL}</math> for children and 255 $\mu\text{g}/\text{dL}</math> for adults) (2). In 2004, a child in Oregon had a BLL of 123 $\mu\text{g}/\text{dL}</math> after ingesting a necklace with high lead content (3). The same year, the Consumer Product Safety Commission (CPSC) recalled 150 million pieces of imported metallic toy jewelry sold in vending machines. Some lead-contaminated items intended for use by children are manufactured in countries with limited government regulation of lead in consumer products (4). With the decline in BLLs in U.S. children (5), widespread education of the dangers of lead paint, and systematic reduction of lead hazards in U.S. housing, acute ingestion of lead-containing items has become increasingly more common as a source of life-threatening BLLs.$$$$

- February 2006, a boy aged 4 years with a previous medical history of microcephaly and developmental delay was brought to a hospital pediatric emergency department in Minneapolis, Minnesota, with a chief complaint of vomiting
- Charm was 99.1% lead
- The next day, a BLL of 180 $\mu\text{g}/\text{dL}</math> was reported$



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Case Study #1



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Case Study #1

- Background:
 - 38 yo female presents to PCP over the course of months with multiple symptoms:
 - Nausea and vomiting
 - Confusion/dizziness
 - Headaches
 - Ataxia
 - Chest tightness/Shortness of breath
 - Lethargy
 - Nosebleeds
 - Easy bruising and bleeding gums
 - Lives w/ husband and 15 yo son
 - Occupation:
 - Homemaker/Student (on-line)

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Case Study #1

- Background:
 - Medical Hx:
 - Migraines (current)
 - Past hx physical abuse by high school boyfriend
 - Anorexia/Bulimia eating disorder (in remission 10 yrs)
 - Abnormal Pap 11 years ago
 - Hospitalizations/Surgeries:
 - Vaginal delivery x3
 - LEEP procedure
 - Inpatient treatment for eating disorder
 - Medications
 - Vicodin (hydrocodone w/ acetaminophen) for headache
 - Relpax (eletriptan) for headache

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Initial Lab Test Results

Hematology	
CBC	Result
Hemoglobin	14.2
Hematocrit	42.4
Erythrocytes	4.5
MCV	94
RDW	11.9
Leukocytes	4.6
Platelets	366
Auto Diff	
Neutrophils	61
Lymphocytes	28
Monocytes	11
Eosinophils	1
Basophils	1

Chemistry	
Sodium	142
Potassium	4.2
Calcium	9.9
Protein, Total	8.6 H
Glucose	94
AST	25
ALT	13
Creatinine	0.6
Albumin	4.7
BUN	13
Chloride	99
Bicarbonate	30

Urinalysis	
Source	Clean void
Appearance	clear
Specific gravity	1.015
pH	5
Glucose	Negative
Protein	1+

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Referral to Otolaryngology

- ENT concerns/complaints:
 - Nosebleeds
 - Fluid in ears leading to dizziness, imbalance, nausea, and vomiting

- ENT exam:
 - Negative
 - Dry nasal mucous membranes
 - List of complaints which don't fit ENT diagnosis
 - Nosebleeds, gum bleeding, easy bruising: possible bleeding disorder; work up through Hematology
 - Headache, nausea, imbalance, memory loss; should assess by Neurology

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Referral to Neurology

- Neurological complaints (numerous and don't localize into one portion of CNS):
 - Confusion/forgetfulness
 - Balance is off, walks into door frames/furniture – leads to bruises
 - Food tastes like “copper”

- Neuro exam:
 - Normal
 - Gait and station are unremarkable
 - Orientation/memory: appropriate
 - Recommend MRI of head and EEG (electroencephalogram)
 - Results negative for intracranial hemorrhage, mass lesion or acute infarction

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Referral to Hematology

- Hematology complaints:
 - Easy bruising
 - Bleeding gums/nosebleeds

- Heme exam:

Hematology			Chemistry			Coagulation		
CBC	Previous	Current	Previous	Current	Previous	Current	Previous	Current
Hemoglobin	14.2	10.5 L	Sodium	142	139	PT	ND	9.5
Hematocrit	42.4	30.0 L	Potassium	4.2	3.5	aPTT	ND	11.0
Erythrocytes	4.5	3.25 L	Calcium	9.9	8.5	APTT	ND	23
RDW	11.9	12.4	Protein, Total	8.8 H	6.4	TT	ND	15
Leukocytes	4.5	6.4	Glucose	94	80	Platelet Aggregation	ND	Normal
Platelets	355	274	AST	25	30			
			ALT	13	15			
Auto Diff			Creatinine	0.5	0.5			
Neutrophils	81	59	Albumin	4.7	4.2			
Lymphocytes	20	32	BUN	13	11			
Monocytes	11	5	Chloride	99	104			
Eosinophils	1	0	Bicarbonate	30	29			
Basophils	1	1						

- Recommend ultrasound to check for thrombus or evolving hematoma
 - Results normal (no DVT)

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Repeat CBC

Hematology	Original	Previous	Current
CBC			
Hemoglobin	14.2	10.5 L	12.1
Hematocrit	42.4	30.0 L	35.3
Erythrocytes	4.5	3.23 L	3.77 L
MCV	94	93	94
RDW	11.9	12.4	13.9
Leukocytes	4.6	6.4	6.6
Platelets	366	274	410
Auto Diff			
Neutrophils	61	59	78
Lymphocytes	26	32	16
Monocytes	11	8	6
Eosinophils	1	0	0
Basophils	1	1	0

- Patient referred to Mayo for further evaluation

Heavy Metal Testing Performed

- 24hr urine results:

Toxicology	Result (mcg/spec)	Reference Range
Arsenic-24 hr Urine	<15	0-35
Lead-24 hr Urine	<1	0-4
Mercury-24 hr Urine	1,817	0-9
Cadmium-24 hr Urine	<0.2	0-1.3

- Blood test result:
 - Mercury: **111 µg/L** (<10 µg/L = normal)
- Referral for Toxicology consult

Mercury

- **Forms:**
 - Elemental form (Hg⁰) shiny, silver-white liquid, crosses blood-brain barrier/placenta
 - Inorganic form (combines with Cl, S, O) is mildly toxic (Hg²⁺)
 - Organic (combine with C)/methylated form (HgMe₂) is extremely toxic; methylation occurs by microorganisms
- **Sources:**
 - Environmental: natural outgassing from granite rock/volcanic activity, burning coal and waste, mining ore deposits, food (shellfish/fish)
 - Home: electrical switches, thermostats, thermometers
 - Occupational: paper & pulp industry, latex paint manufacturing (fungicide), plastic industry, jewelry making
 - Miscellaneous: dental amalgam
- **Routes of Exposure:**
 - Inhalation (75-85% Hg⁰ absorbed)
 - Ingestion (Hg⁰ 0.01%, inorganic 20%, HgMe₂ 100% absorbed)
 - Dermal

Common Sources of Exposure to Mercury

- Eating fish or shellfish contaminated with methylmercury
- Breathing vapors in air from spills, incinerators, and industries that burn mercury-containing fuels
- Release of mercury from dental work and medical treatments
- Breathing contaminated workplace air or skin contact during use in the workplace (dental, health services, chemical, and other industries that use mercury)
- Practicing rituals that include mercury.
 - Latino and Afro-Caribbean traditions use mercury to: attract luck, love, or money; protect against evil; or speed the action of spells.
 - Done through a variety of uses, including wearing in amulets, sprinkling on the floor, or adding to a candle, oil lamp or cosmetic products.

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What is the Source of Mercury for Case#1

- Environmental:
 - Dietary: No fish/shellfish intake
 - Dental: No fillings
 - No mercury rituals
- Occupational:
 - At home student/homemaker
- Home:
 - Husband reports description of mercury "balling" up in furnace HEPA filter
 - Structural house fire (March)
 - Extensive damage/renovations
 - Out of house until September
 - Furnace destroyed/replaced
 - Insurance company limiting what can be replaced vs. left "as is"



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Symptoms of Acute and Chronic Mercury Poisoning

Target System	Acute	Chronic
Neurologic	Fatigue, Insomnia, Hearing loss, <u>Headache</u> , <u>Confusion</u> , <u>Lethargy</u> , <u>Seizures</u> , <u>Ataxia</u>	Tremors, Ataxia (lower extremities), Delirium
GI tract	<u>Metallic taste</u> , <u>Nausea</u> , <u>Vomiting</u> , <u>Diarrhea</u>	Loose teeth, blue gums
Pulmonary	<u>Respiratory distress</u> , Pneumonitis, Edema	
Hematologic	Thrombocytopenia, <u>Anemia</u>	

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Mercury continued

- Mechanism of Action:
 - Inorganic mercury (Hg^{+2}) readily binds to sulfhydryl groups on a protein (which play an integral part in the structure/function of most proteins), distorting tertiary configuration and causing loss of activity
 - In addition, tertiary changes may cause some proteins to become immunogenic, eliciting T lymphocyte proliferation and Immunoglobulins to bind to the new antigen (collagen tissues are particularly sensitive)
 - $Hg(CH_3)_2$ species are lipophilic and avidly bind to lipid-rich tissues such as neurons (myelin is susceptible to disruption by this MOA)

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Treatment/Management of Mercury Toxicity

In the following order, as necessary:

1. Identify and remove the patient from the source of exposure
2. Supportive measures
3. Chelation therapy (reduce body burden):
 - 2,3-Dimercaptopropane-1-sulfonate (DMPS)
 - D-penicillamine
 - Dimercaprol or BAL (contraindicated for elemental and organic mercury compounds since increases brain levels)
4. Hemodialysis w/ infusion of a chelator (cysteine, N-acetylcysteine) in severe cases

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Case Study #1 Continued


- Advised not to proceed with any chelation therapy, first identify source of mercury and remove it
- WI Dept Public Health/EPA investigation:
 - Sources of exposure:
 - Gas Magic Chef range
 - Furnace (>40 yr old, destroyed in fire)
- Family given permission to move back home after removal
- Follow-up blood testing:
 - Elimination half-life (20-65 days)

Toxicology	Original (May)	June	July	Aug
Mercury-Blood	111 µg/L	44 µg/L	12 µg/L	8 µg/L

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Case Study #2



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Case Study #2

- Background:
 - Family moved into a 1900's home 6 months ago
 - Father (29 yr)
 - Son (4 yr)
 - Son (14 months)
 - Remodeling house since day 1
 - Brought his kids to the family physician for a wellness check



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Case Study #2 (4 year old)

- Physical Exam:
 - General: pleasant, interactive 4 yr old, no acute distress
 - Skin: Warm, well perfused
 - ENT: Moist mucous membranes, no oral lesions or pharyngeal erythema
 - Heart: Regular rate/rhythm, no murmurs
 - Lungs: Clear, no wheezes
 - Abdomen: Normal bowel sounds, soft, non-distended, non-tender to palpitation
- History:
 - Father notes child has been hyperactive the past month
 - Patient complains of abdominal cramping/pain; difficulty hearing
 - No change in appetite

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Initial Lab Test Results (4 year old)

Hematology		Chemistry		Urinalysis	
CBC	Result	Sodium	140	Source	Clean void
Hemoglobin	12.1	Potassium	4	Appearance	amber
Hematocrit	36	Calcium	10.1	Specific gravity	1.02
Erythrocytes	4.3	Protein, Total	2.2	pH	5.5
RDW	80	Glucose	88	Glucose	Negative
Leukocytes	10	AST	26	Protein	Negative
Platelets	4.6	ALT	24		
Auto Dif	320	Creatinine	1		
Neutrophils	60	Iron	59		
Lymphocytes	30	BUN	13		
Monocytes	10	Chloride	100		
Eosinophils	0	Bicarbonate	30		
Basophils	0				

- Lead (Blood): 39.5 mcg/dL (Ref Range: <5 mcg/dL)

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Case Study #2 (14 month old)

- Physical Exam:
 - General: awake, alert and in no apparent distress
 - Skin: Warm, pink
 - ENT: Moist mucous membranes
 - Heart: Regular rate/rhythm, no murmur
 - Lungs: Clear
 - Abdomen: Normal bowel sounds, soft, non-distended, non-tender to palpation

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Initial Lab Test Results (14 month old)

Hematology		Chemistry		Urinalysis	
CBC	Result	Sodium	139	Source	Clean void
Hemoglobin	10.8 L	Potassium	4.2	Appearance	amber
Hematocrit	31 L	Calcium	9.8	Specific gravity	1.02
Erythrocytes	3.6 L	Protein, Total	7.8	pH	5.5
RDW	72 L	Glucose	94	Glucose	Negative
Leukocytes	10	AST	24	Protein	Negative
Platelets	5.1	ALT	24		
Auto Dif	360	Creatinine	0.9		
Neutrophils	58	Iron	32 L		
Lymphocytes	32	BUN	13		
Monocytes	10	Chloride	101		
Eosinophils	0	Bicarbonate	28		
Basophils	0				

Basophilic stippling: present

- Lead (Blood): 47.8 mcg/dL (Ref Range: <5 mcg/dL)

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Lead

- **Properties:**
 - No known biological function
 - Ubiquitous (air, food, water, and soil)
- **Sources:**
 - **Environmental:** paint (up to 1972), gasoline (1978), water, soil near industrial sites/freeways
 - **Occupational:** battery manufacturers/foundries, plumbers, auto repair, mining
 - **Hobbies:** glazes/pottery making, target shooting/slugs
 - **Miscellaneous:** cigarettes, folk remedies/cosmetics, moonshine whiskey
- **Routes of exposure:**
 - Inhalation:
 - Ingestion:
 - Children (~50%) / Adults (~10%)
 - Dermal: (<inhalation/ingestion)

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Importance of Diet/Nutritional Status

Healthy Foods to Fight Lead

Foods High in Calcium	Foods High in Iron	Foods High in Vitamin C
<ul style="list-style-type: none"> •Milk •Yogurt •Low-fat cheese •Tofu •Low-fat cottage cheese •Evaporated milk •Foods made with milk; including soups, custards, and puddings •Powdered milk 	<ul style="list-style-type: none"> •Lean red meat •Low-fat pork •Dried beans and peas •Raisins •Iron fortified cereal •Iron fortified infant formula •Breast milk 	<ul style="list-style-type: none"> •Oranges/Orange juice •Grapefruit/Grapefruit juice •Dark green, leafy vegetables •Potatoes cooked in the skin •Broccoli •Cabbage •Strawberries

<http://www.health.state.mn.us/divs/eh/lead/faqs.html#Diet> ©2012 MPMER | 4/20/15

Distribution of Lead in the Body

- 95% long bones.
- 4% brain, liver, kidneys.
- 1% blood.

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Lead Toxicity: Signs & Symptoms

- Symptomatic lead poisoning is uncommon:
 - <45 µg/dL in children and <60 µg/dL in adults are usually asymptomatic
- Signs and symptoms:
 - - Severe abdominal pain
 - - Fatigue
 - - Mental confusion/poor concentration
 - - Headache
 - - Vomiting
 - - Ataxia
 - - Weight loss
 - - Constipation
 - - Seizures
 - - Coma/Death

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Health Effects of Lead

- Concentration related
- IQ/ delinquency related to total dosage in childhood

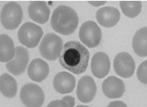
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Lead Effects Heme Synthesis

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Laboratory Assessment

- **Blood lead level**
 - Definitive test
 - Measured by: ICP-MS or atomic absorption spectrometry
 - Venous (gold standard) vs. capillary blood
 - EDTA whole blood = specimen of choice
 - $t_{1/2} = \sim 30-50$ days
 - Updated reference ranges: Blood lead levels in the range of 5-9 mcg/dL have been associated with adverse health effects in children aged 6 years and younger
- **Erythrocyte protoporphyrin (EP) or zinc protoporphyrin (ZPP)**
 - $t_{1/2} = \sim 68$ days
 - Concentration >60 $\mu\text{g/dL}$ is a significant indicator of exposure
- **Other technologies**
 - Anodic stripping voltammetry (ASV)
 - K-X-ray fluorescence (measure lead content of bone)
- **Hematological (CBC) findings**
 - Normochromic/normocytic or hypochromic/microcytic
 - Basophilic stippling



Case Study #2 Continued

- Family sent to ED for follow-up testing:
 - 4 yo lead (blood): 33 mcg/dL (previous 39.5)
 - 14 month lead (blood): 55 mcg/dL (previous 47.8)
 - Father lead (blood): 51 mcg/dL
- Toxicology consult:
 - Local health agency contacted to evaluate home
 - Paint contained lead; abatement done
 - Family stayed outside home until removal and renovations were complete
 - Father's other labs were normal with the exception of a low iron (41 mcg/dL)

State Regulations for Laboratory Reporting of BLL (MN 144.9502)

- Reports of blood lead analysis required:
 - (a) Every hospital, medical clinic, medical laboratory, other facility, or individual performing blood lead analysis shall report the results after the analysis of each specimen analyzed, for both capillary and venous specimens, and epidemiologic information required in this section to the commissioner of health, within the time frames set forth in clauses (1) and (2):
 - (1) within two working days by telephone, fax, or electronic transmission, with written or electronic confirmation within one month, for a venous blood lead level equal to or greater than 15 micrograms of lead per deciliter of whole blood; or
 - (2) within one month in writing or by electronic transmission, for any capillary result or for a venous blood lead level less than 15 micrograms of lead per deciliter of whole blood.

Treatment and Management

Recommendations from the Advisory Committee on Childhood Lead Poisoning Prevention

Blood Lead Level (µg/dL)				
10 - 14	15 - 19	20 - 44	45 - 69	>69
Lead education -Dietary -Environmental Follow-up blood lead monitoring	Lead education -Dietary -Environmental Follow-up blood lead monitoring Proceed according to actions for 20-44 µg/dL, if: -A follow-up BLL is in this range at least 3 months after initial venous test or -BLLs increase	Lead education -Dietary -Environmental Follow-up blood lead monitoring Complete history and physical exam Lab work: -Hemoglobin or hematocrit -Iron status Environmental investigation Lead hazard reduction Neurodevelopmental monitoring Abdominal X-ray (if particulate lead ingestion is suspected with bowel decontamination if indicated	Lead education -Dietary -Environmental Follow-up blood lead monitoring Complete history and physical exam Lab work: -Hemoglobin or hematocrit -Iron status -FEP or ZPP Environmental investigation Lead hazard reduction Neurodevelopmental monitoring Abdominal X-ray with bowel decontamination if indicated Chelation therapy	Hospitalize and commence chelation therapy Proceed according to actions for 45-69 µg/dL

http://www.cdc.gov/nceh/lead/casemanagement/casemanage_chap3.htm#Table 3.1

Case Study #2 Continued

- Treatment:
 - Father (51 mcg/dL): No chelation therapy; start multi-vitamin (Fe)
 - Asymptomatic
 - Renovations done/exposure source removed
 - 4 year old (33 mcg/dL): No chelation therapy
 - Renovations done/exposure source removed
 - ENT evaluation showed normal hearing
 - Monitor blood level (declining) vs. side effects of treatment
 - 14 month old (55 mcg/dL): Chelation therapy
 - Oral succimer (200 mg @ 0800, 200 mg @ 1400, and 100 mg QHS)
 - Iron (75 mg PO BID)
 - Monitor blood lead levels, CBC, Iron, Cr, LFTs



Case Study #3



Clinical Case Study #1

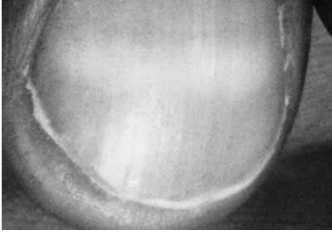
- 50 yo man admitted to hospital
- Signs/Symptoms:
 - Dry, itchy skin, nausea, vomiting, diarrhea, general tiredness, weight loss (25 lbs-past 2 months), garlic-like breath
- History:
 - Multiple hospital admissions in the past year:
 - Nausea/vomiting but normal abdominal exam
 - Neurologic exam: decreased muscle strength in lower extremities
 - Cyclic neutropenia, hyperpigmented skin
- Lab results:

	<u>Previous Visit</u>	<u>Current Visit</u>
• Leukocyte count:	1.4 x 10 ³ ↓	N.D.
• BUN:	35 mg/dL ↑	55 mg/dL ↑
• AST:	30 U/L	1520 U/L ↑
• ALP:	N.D.	550 U/L ↑
• LD:	N.D.	840 U/L ↑
• Creatinine:	N.D.	2.8 mg/dL ↑

 - Additional findings on current visit:
 - ↑PT, ↑aPTT, Thrombocytopenia

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Clinical Case Study #1 Continued




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Arsenic

- **Forms:**

Inorganic (Toxic)	Organic (Nontoxic)
Trivalent (As ³⁺)	Mono- and di-methyl arsine
Pentavalent (As ⁵⁺)	Arsenobetaine
	Arsenocholine
- **Sources:**
 - Pesticides (largest source)
 - Occupational: Industrial (copper/zinc/lead) smelting, Electronics industry, Glass manufacturing
 - Misc: Wood preservative, soil, water (most <5 µg/L but some > 50 µg/L), and food (meats/seafood/veg; 0.04 mg/day).
- **Routes of Exposure:**
 - Inhalation:
 - Ingestion: (almost complete absorption)
 - Dermal:
- **Elimination:** Primarily kidney (urine).



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Arsenic

- Properties:**
 - Half-life: ~10 hr
 - Crosses the placenta
 - Garlic-like odor
 - Concentrates in hair and nails (Mees Lines).
- 3 Mechanisms of Toxicity:**
 - Arsenic binds to any hydrated sulfhydryl group on a protein, distorting 3D configuration and causing loss of activity
 - Arsenic covalently binds to dihydrolipoic acid, a necessary cofactor for pyruvate dehydrogenase, inhibiting the conversion of pyruvate to acetyl coenzyme A (first step in gluconeogenesis). Results in loss of energy supply to anaerobic cells. (Predominant MOA on neural cells leading to bilateral peripheral neuropathy)
 - Arsenic competes with zinc for mitochondrial respiration, leading to a loss of energy loss—poor synthesis by arsenite which is sensitive to

The diagram illustrates the metabolic pathway where Pyruvate is converted to Acetyl CoA by the enzyme Pyruvate dehydrogenase (dihydrolipoate cofactor), which then enters the Citric Acid Cycle. Below this, a chemical reaction shows arsenic ($As(OH)_3$) binding to the sulfur atom of a sulfhydryl group ($-SH$) on a dihydrolipoic acid molecule, forming a covalent bond ($-S-As-OH$).

Arsenic Toxicity

- Nervous System:** Destruction of myelin
- Renal:** Acute tubular necrosis
- Liver:** jaundice-indicative of chronic exposure can progress to cirrhosis.
- Cardiovascular effects:** Decreased contractility (arrhythmias)
- Hematopoietic effects:** Anemia and leukopenia, occur a few days following exposure and are reversible.
- Cellular effects:** Impairs mitochondrial enzymes and tissue respiration.
- Carcinogen:** Lung cancer, and skin cancer-hyperpigmentation and hyperkeratosis.
- Death** (70–180 mg)

Arsenic Toxicity: Signs & Symptoms

- Skin/Nails:** Hyperpigmentation, Mees' lines
- Neurologic:** Bilateral peripheral neuropathy (most common)
- Renal:** Acute nephropathy with proteinuria of unexplained etiology
- Cardiovascular:** Acute cardiovascular collapse of unexplained etiology, arrhythmia
- GI:** Nausea, vomiting, diarrhea, weight loss
- Hematologic:** Anemia, leukopenia, thrombocytopenia

Laboratory Assessment

Specimen	Reference Range	Fatal
Whole Blood	0-12 ng/mL	100-600 ng/mL
Urine	0-35 µg/L	100-400 µg/L
Hair	0-0.9 µg/g	
Nails	0-0.9 µg/g	

Note: Urine is the best screening test to detect arsenic exposure. However, the total arsenic determination is only partially useful and fractionation testing must be done to distinguish between the toxic inorganic and nontoxic organic forms

Treatment

- BAL used to treat chronic arsenic poisoning, acute dermatitis and the pulmonary symptoms of excess arsenic exposure.

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Seafood Contains Arsenic



After a seafood meal (seafood contains a nontoxic, organic form of arsenic), the urine output of arsenic may increase to 300 mcg/24 hours for 1 day, after which it will decline to <25 mcg/24 hours.

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Case #1 Continued

- Laboratory results:
 - Arsenic:
 - Urine: 980 µg/L (0-35 µg/L)
 - Arsenic Fractionation:
 - Urine:
 - Inorganic: 905 µg/L
 - Organic: 75 µg/L
- Patient expired before chelation therapy was begun

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Heavy Metal Summary

- Symptoms of heavy metal poisoning may be absent or vague:
 - Nausea
 - Vomiting
 - Sudden, unexplained weight loss
 - Peripheral neuropathy
- Elevated total heavy metal results should be interpreted with caution
 - Are symptoms present?
 - Speciation can be done to determine the presence of toxic or nontoxic species
 - Rule-out contamination (venous vs capillary)
 - Other sources (seafood consumption) of heavy metal
- Treatment
 - Identify and remove the source
 - Chelation therapy if necessary

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Questions & Discussion

A sure sign of good parenting is finding 80's heavy metal music on your kid's ipod!



someecards
water cards

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Self-Assessment Questions

- A 3 year-old child is brought to the Emergency department because of a week-long history of abdominal discomfort, irritability, and weakness. A complete blood count and blood smear demonstrate microcytic, hypochromic anemia with basophilic stippling of the red blood cells. Further history reveals that the family lives in a very old apartment complex with peeling paint. The most likely cause of the hematologic findings is:
 - A. Binding of carbon monoxide to hemoglobin
 - B. Inhibition of cytochrome oxidase
 - C. Inhibition of hemoglobin production caused by lead
 - D. Zinc deficiency
 - E. Iron intoxication

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Self-Assessment Questions

- A 48 year-old woman with a diet rich in fish/shellfish was admitted to the hospital. Her clinical history in the previous 5 days included progressive deterioration in balance, gait, and speech. She had lost 15 pounds during the prior 2 months and had periods of nausea, diarrhea, and abdominal discomfort. She complained of a metallic taste and had a blue line along her gums.
- These findings/history are most consistent with exposure to what heavy metal?
 - A. Chromium
 - B. Lead
 - C. Mercury
 - D. Copper
 - E. Cadmium

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Self-Assessment Questions

- To screen for lead toxicity in a child, what is the preferred sample type?
 - A. Hair
 - B. Capillary EDTA whole blood
 - C. Venous EDTA whole blood
 - D. Sodium citrate plasma
 - E. Random urine

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