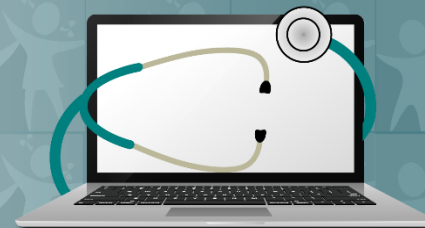




PEHSU NATIONAL CLASSROOM

Pediatric Environmental
Health Specialty Units



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Webinars

Series of scientific webinars that provide a forum for discourse on scientific issues.

Live and On-Demand

Case Conferences
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Online Courses

Evidence-based online courses on a variety of children's environmental health topics.

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Resource Catalog

Fact sheets, journal publications, reports, and other resources for parents, community members, patients and healthcare professionals

Topics included:
Air Quality, Pesticides,
Natural Disasters, BPA,
Mold, Lead, Mercury

What's floating around out there?

Thomas M. Nappe, DO
Rocky Mountain Poison & Drug Center
Denver Health & Hospital Authority
Region 8

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Case 1

Case 1

- A 17-year-old male was found wandering the streets around midnight with altered mental status.
- He reported that he was in the woods earlier that day and ate a large amount of berries that he foraged.
- He claimed to have grinded the berries and distilled them, and then injected the distillate and ingested the remaining resin

Case 1

- He soon decompensated with tachycardia, hypotension, and decreased mental status. He was resuscitated with IVF, started on vasopressors, intubated placed on CRRT.
- Labs upon arrival (intubated)
 - 14:50: 7.08/26/149/7.3
 - 15:50: 7.2/23/220/10.4
 - Na 140, Cl 101 K 4.7, HCO₃ 11, BUN 40, Cre 3.02, Glu 147
 - AST 57, ALT 175, TBR 1.3, AP 315
 - Troponin 2.51, lactate 14.6
 - WBC 18.3, HGB 13.9, HCT 41.1, Plt 48
 - INR 5.9 → >15.2, Fib 91 → <20
- He died 6 hrs after presenting to our facility, ~20 hrs after initial presentation.

Case 1

- What is the differential diagnosis?
- What other tests would you have considered?
- Would you have considered any other treatment modalities in this patient?

Case 1 (continued)

- A “friend” who had recently seen the patient noted that he mentioned finding castor beans in the woods
- Postmortem evaluation revealed “**ricinine**” in his urine

Ricin

- A toxalbumin extracted from castor beans (*Ricinus communis*)
- Inhibits protein syntheses by inhibiting 28S subunit of the 60S ribosome
- Causes multiorgan failure
 - Cardiac
 - Renal
 - Hepatic
 - Hematologic



Ricinine

- A potential biomarker for Ricin (CDC)

Case report

Suicidal death after injection of a castor bean extract (*Ricinus communis* L.)

Vera Coopman^a, Marc De Leeuw^{b,c}, Jan Cordonnier^{a,*}, Werner Jacobs^c

^aDepartment of Analytical Toxicology, Chemiphar N.V., Lieven Bauwensstraat 4, B-8200 Brugge, Belgium

^bEmergency Department, Algemeen Stedelijk Ziekenhuis, Merestraat 80, B-9300 Aalst, Belgium

^cCentre for Forensic Medicine, Antwerp University Hospital, Wilrijkstraat 10, B-2650 Edegem, Belgium

- Patient presented after reportedly injecting himself with castor bean resin, and progressed to multiorgan failure and died 33 hours later. Ricinine found in the vitreous fluid was believed to be confirmatory
- CDC: Ricinine in biological specimen AND sample

<http://emergency.cdc.gov/agent/ricin/qa.asp>

Ricinine

J Anal Toxicol. 2013 May;37(4):237-40. doi: 10.1093/jat/bkt010. Epub 2013 Mar 6.

Analysis of a ricin biomarker, ricinine, in 989 individual human urine samples.

Pittman CT¹, Guido JM, Hamelin EI, Blake TA, Johnson RC.

- **Ricinine** (3-cyano-4-methoxy-N-methyl-2-pyridone)
 - **urinary biomarker** to confirm human exposure to castor bean products such as ricin.
 - **Ricinine may be detectable in the general population**
 - **Many consumer products contain castor oil, another castor bean product**
 - The study characterized urinary ricinine concentrations from 989 individuals who were presumed to be unexposed to ricin.
- 1.2% of the urine specimens had detectable amounts of ricinine

Case 1 (Concluded)

- Cause of death was not yet determined

Case 2

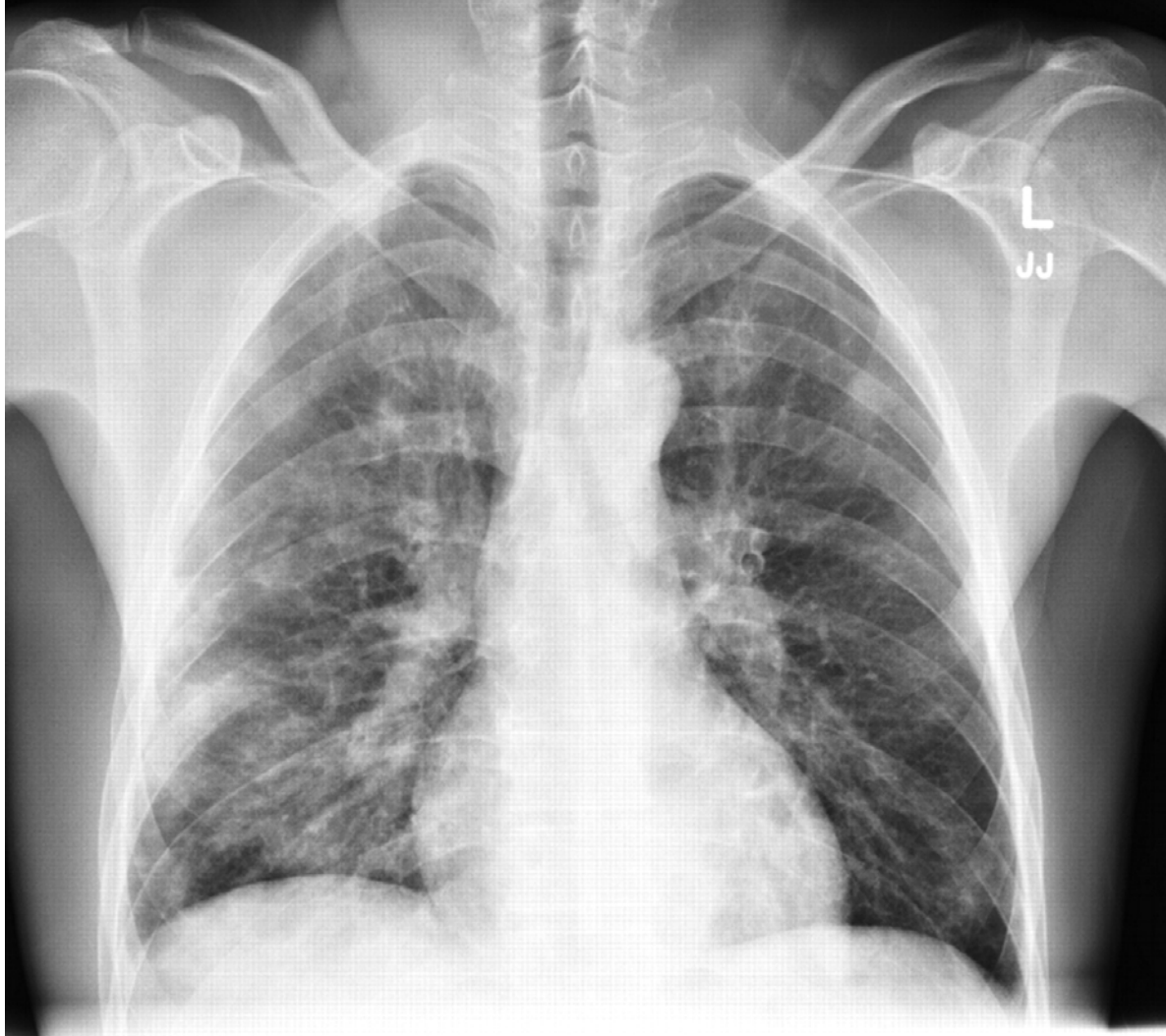
Case 2

- A 32-year-old man was making a hand-crafted ceremonial knife in his kitchen at 2am, from what he thought was silver, which he obtained from his late grandfather's dentist office.
- The knife was to cut the umbilical cord of his newborn baby who was due the next week.
- His 26-year-old pregnant wife was in the next room sleeping.

Case 2 (continued)

- His wife awoke to find him short of breath and coughing. She opened the windows and brought him to the emergency department, where he was dyspneic with a HR of 122, RR 34, and oxygen saturation of 88%, and a CXR was performed. After no improvement with supplemental oxygen, he required BIPAP for support.

Case 2: CXR



Case 2

- What metal is suspect and in what form?
- What sort of mercury exposure are we dealing with and what can we expect?

Goldfrank's Table 98-2. Classes of Mercury Compounds

	<i>Chemical Formula</i>	<i>Example</i>
Elemental	Hg^0	Quicksilver
Inorganic	Hg^+	Mercurous ion
	HgCl	Calomel, mercurous chloride
	Hg^{2+}	Mercuric ion
	HgCl_2	Mercuric chloride
Organic	Short-chain alkyl–mercury compounds	Methylmercury Ethylmercury Dimethylmercury
	Long-chain mercury compounds	Methoxyethylmercury
	Aryl mercury compounds	Phenylmercury

Goldfrank's Table 98-3. Exposures to Mercury

	<i>Elemental</i>	<i>Inorganic</i>	<i>Organic</i>
Manufacturing/ Industrial	Barometers	Batteries	Agriculture
	Bronzing	Chemistry sets	Embalming
	Ceramics	Dyes	Fungicides
	Chlorine manufacture	Explosives	Laboratory reagents
	Electroplating	Fireworks	Pesticides
	Jewelry	Laboratory reagents	Wood preservatives
	Paints	Tanneries	
	Paper pulp	Taxidermy	
	Photography	Vinyl chloride manufacture	
	Metal refineries		
Medical/Medicinal	Amalgam	Antiseptics	Bactericidals
	Sphygmomanometry	Calomel	Preservatives
	Tissue fixatives	Disinfectants	Pharmaceuticals
	Thermometers	Laxatives	
	Weighted nasogas- tric tubes		
	Patent		
Food/Other	Ritualistic use		Seafood
	Esthetic?		Grains
	Ayurvedic		(contaminated)

Goldfrank's Table 98-3. Differential Characteristics of Mercury Exposure

	<i>Elemental</i>	<i>Inorganic</i>	<i>Organic</i>
Primary route of exposure	Inhalation	Oral	Oral
Primary tissue distribution	CNS, kidney	Blood (transient, acute) Kidney CNS (delayed)	CNS, kidney, liver, blood, hair
Clearance	Renal, GI	Renal, GI	Methyl: GI Aryl: renal, GI
<i>Clinical effects</i>			
CNS	Tremor	Tremor, erethism	Paresthesias, ataxia, tremor, tunnel vision, dysarthria
Pulmonary	+++	—	—
Gastrointestinal	+	+++ (caustic)	+
Renal	+	+++ (ATN)	+
Acrodynia	+	++	—
Therapy	BAL, DMSA	BAL, DMSA	DMSA (early)

ATN = acute tubular necrosis; BAL = British anti-Lewisite; CNS = central nervous system; DMSA = dimercapto-succinic acid; GI = gastrointestinal.

Case 2

The husband was weaned off BIPAP 6 hours later and was doing well. A call was placed to the Poison Center to discuss the asymptomatic pregnant wife.

- Should any **tests** should be ordered to assess, and if so which tests?
- Should mother be **chelated**?

Mercury - Diagnostic Testing

- **24 hour urine**
 - Chronic exposure
 - Confirmatory
 - Acid washed container
- **Whole blood**
 - Acute inorganic
 - Organic Hg
- **Renal function**

Mercury - Treatment (Chelation) Options

- **Elemental or inorganic**
 - Dimercaprol (BAL)
 - Succimer if can tolerate PO
- **Organic**
 - DMSA or succimer
 - *BAL may increase brain organic Hg concentration*

Mercury - Potential Adverse Effects of Chelation

- Succimer
 - Also chelates zinc and copper
 - Could have adverse outcomes for pregnant patient and child
- Dimercaprol (BAL)
 - May increase organic Hg brain concentration

INCREASED BRAIN UPTAKE OF MERCURY INDUCED BY 2,3-DIMERCAPTO-
PROPANOL (BAL) IN MICE EXPOSED TO
PHENYLMERCURIC ACETATE¹

M. BERLIN AND R. RYLANDER

*Institute of Hygiene, Karolinska Institutet, and the
Department of General Hygiene, National Institute of Public Health
Stockholm, Sweden*

Accepted for publication July 24, 1964

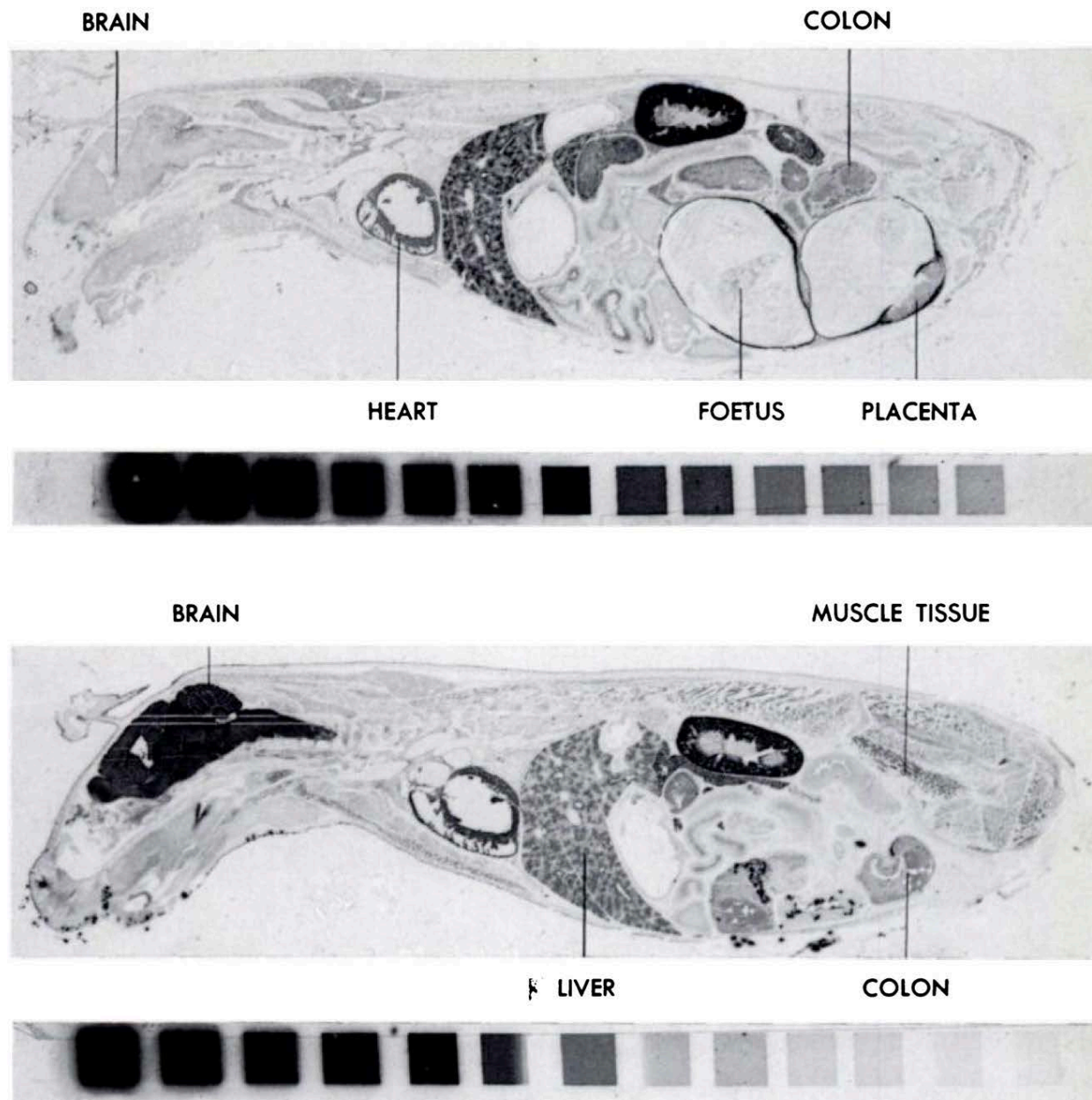


FIG. 3. Autoradiograms of sagittal whole-body sections of mice 8 days after injection of phenyl-Hg²⁰³ acetate (0.5 mg Hg/kg) (upper) and phenyl-Hg²⁰³ acetate (0.5 mg Hg/kg) + BAL (0.4 mg/kg) (lower). Dosages given in text. The isotope reference scales accompanying the sections are shown; the activity ratio between adjacent steps is $1/2$. The upper section is taken from a pregnant mouse.

Case 2 (continued)

- Mother's whole blood Hg > 600 µg/dL
- Should she be chelated?

To Chelate or Not?

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PRACTICE GUIDELINE

Elemental mercury exposure: An evidence-based consensus guideline for out-of-hospital management

E. MARTIN CARAVATI, M.D., M.P.H., ANDREW R. ERDMAN, M.D., GWENN CHRISTIANSON, M.S.N., LEWIS S. NELSON, M.D., ALAN D. WOOLF, M.D., M.P.H., LISA L. BOOZE, PHARM.D., DANIEL J. COBAUGH, PHARM.D., PETER A. CHYKA, PHARM.D., ELIZABETH J. SCHARMAN, PHARM.D., ANTHONY S. MANOQUERRA, PHARM.D., and WILLIAM G. TROUTMAN, PHARM.D.

American Association of Poison Control Centers, Washington, District of Columbia, USA

- 7. Pregnant patients unintentionally exposed to elemental mercury and who are asymptomatic should be evaluated by their obstetrician or primary care provider as an outpatient. Immediate referral to an ED is not required (Grade D).**

Elemental mercury exposure: An evidence- based consensus guideline for out-of-hospital management

- 19-year-old-woman with acute exposure to mercury vapor at home by heating mercury-gold amalgam
 - N/V, dyspnea 8hrs after
 - Chelated with penicillamine for 8 days
 - Delivered a normal-term infant 26 days later
 - [Hg]blood day of exposure – Mother: 26 µg/dL
 - [Hg]blood day of delivery – Mother: 3.8 µg/dL, infant: 3 µg/dL

Elemental mercury exposure: An evidence- based consensus guideline for out-of-hospital management

- 29-year-old-woman with chronic exposure to Hg vapor during weeks 1-17 of gestation from mercury spilled on the carpet.
 - Asymptomatic
 - 24-hour urine Hg of 230 $\mu\text{g/L}$
 - Normal-term infant
 - Hair total mercury 3 ng/g at birth
 - Normal exam at 2 years old

Elemental mercury exposure: An evidence- based consensus guideline for out-of-hospital management

- 15-week pregnant woman working in a mercury thermometer plant
 - Elevated urine inorganic mercury 875 $\mu\text{g/L}$ on routine screening.
 - “Viable male infant” delivered

Case 2 (concluded)

- Patient was not chelated
- Delivery occurred uneventfully
- Follow-up [Hg] trended downward for mother
- Hg detectable in newborn's blood (46 µg/dL)
- Hg concentrations trended downward and both remained asymptomatic

7. Pregnant patients unintentionally exposed to elemental mercury and who are asymptomatic should be evaluated by their obstetrician or primary care provider as an outpatient. Immediate referral to an ED is not required (Grade D).

Mercury - Historical Exposures

- Treatment of syphilis and constipation
- **1800s: “Hatters’ Shakes,” “Danbury Shakes”**
 - Mercuric nitrate used to press animal furs into felt
 - Danbury, CT – center for felt hat making
 - The “Mad Hatter”
- 1900s: Calomel (HgCl_2) for teething
- **1940s: Minamata Bay, Japan**
 - **Minamata Bay Disease** resulted from methyl Hg accumulation in marine life which was then eaten
 - Was due to pollution from vinyl chloride plant
 - Profound developmental delay in prenatal exposure;
 - Many unreported deaths
- **1971: Iraq**
 - Methyl Hg used as a fungicide on seed grain that was supposed to be for planting but instead was baked into bread
 - >6500 sick, >400 died

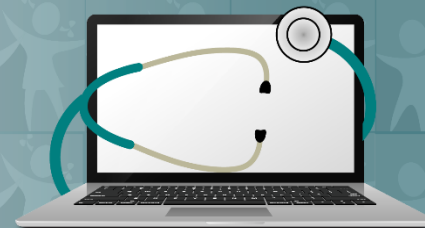
Ricin - Historical Exposures

- **1978 – Assassination of Georgi Markov**
 - Modified umbrella used to fire a tiny ricin-contaminated pellet into his leg
 - Died several days later in hospital
 - Pellet removed from leg on autopsy
 - KGB claimed responsibility years later
- **2013 – Ricin-containing letters** sent to Mayor Bloomberg and President Obama by actress Shannon Richardson, now serving 18 years



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