

Occupational toxicology

Toxic metals

Lead, Mercury

Lead products



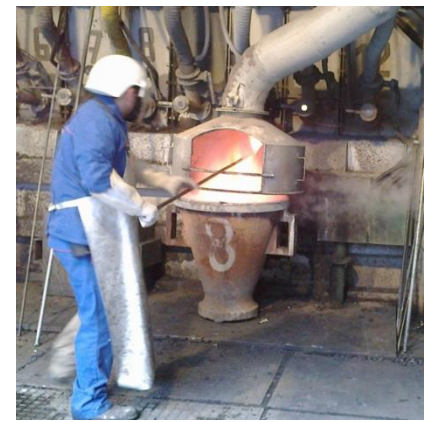
**Lead-paint
white
Basic lead(II)-
carbonate**



**Lead sheet metal,
shots, wire,...**

Exposure: batteries, lead alloys, glazes, lead crystal glass, paints, shots, wire, sheet,...

1. INORGANIC LEAD



- **Pathogenesis:** absorption by **inhalation(40%)**,
- less from GIT (8%),
- plasma fraction to brain (especially in children), kidney, and liver.
- Major deposition is in **bones**, incorporated into the matrix Pb^{2+} .
- Binds to SH groups, interferes with enzymes for hem synthesis.
Bound to **erythrocytes (measured in full blood)**
- Excreted by urine and faeces.
- **Cummulative poison** - half-life is 5-10 years!

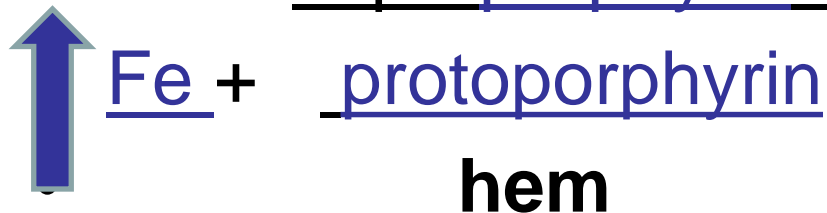
Patophysiology of anaemia

- 5-aminolaevulinic acid

5-ALA dehydratase

- porphobilinogen
- uroporphyrinogen
- coproporphyrinogen

oxidase (copro-o)



hem-synthetase

Signs and symptoms of subacute or chronic intoxication

- **Anaemia** (fatigue, apathy, dyspnoea, pale skin)
- **Colicky abdominal pain**
- **Lead line on the gums.**
- Lead encephalopathy (in children) headache, confusion, coma, seizures.
- Rare: renal proximal tubules injury, hypertension, increased uric acid –lead gout



Findings

- **Anaemia** (normochromic normocyte)

- *basophilic stippling of the red blood cells*
- *(ribosomes, mitochondria)*



- **Czech limit of blood lead 400 µg/l (workers)**
- (Czech population 35 µg/l)



- *increased **protoporphyrin** - FEP or ZPP (free or zinc PP, sign of earlier exposure)*

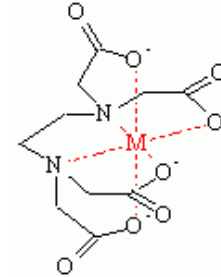
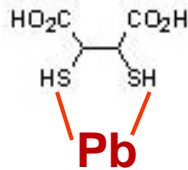
Findings in urine



- Lead in urine – 24 h collection
- increase of intermedial products from hem synthesis:
 - 5-aminolevulinic acid (5-ALA)
 - coproporphyrins

claw or *chele* (Greek)

Treatment

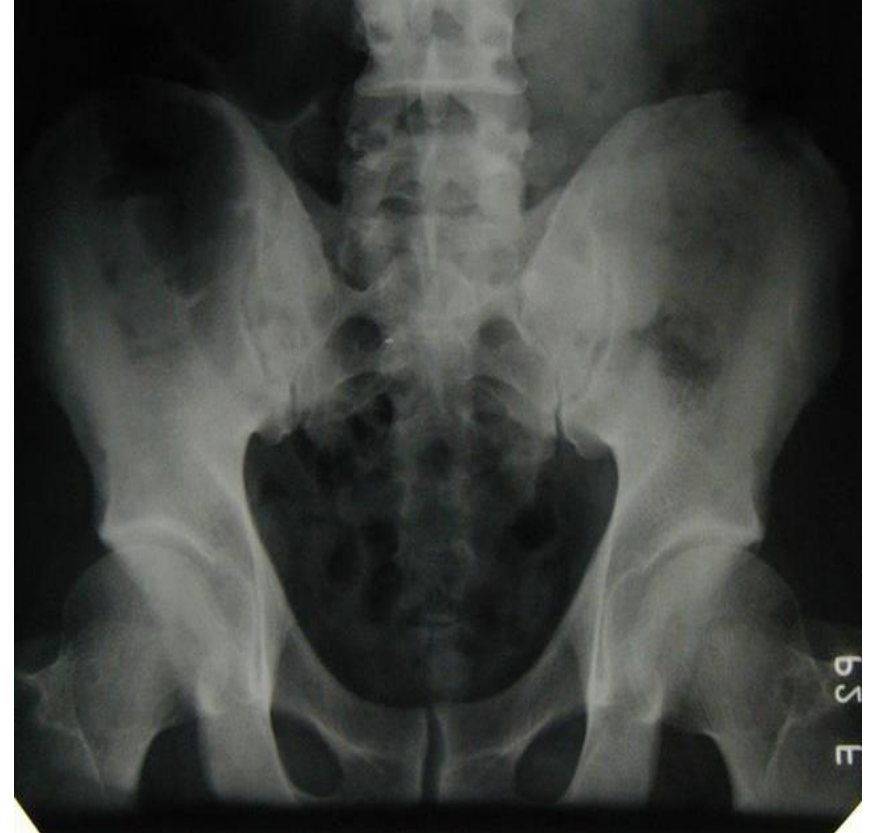


- first step : removal from exposure
- **Chelating antidotes** – STRONG COVALENT BOUND:
- **DMSA (succimer, dimercaptosuccinic acid)** per os capsules – few side effects. Preferred antidote.
- **CaNa₂-EDTA (calciumpdisodium edetate)** i.v. infusion – slightly nephrotoxic
- **Lead-mobilization and 24-hour urine collection** after antidote
- High excretion (= 2 mg Pb during 24-hour urine collection) – a sign of significant body burden.

Lead glaze may cause intoxication of a family



Pb_3O_4 ingestion



Lead shots in GIT of a hunter



Lead shots ingestion in mental anorexia



Intoxication from a lead-based paint – children room

December 2013 –father removed the paint

March 2014 – tiredness, colics

April - anaemia 92 g/l, colics – USG, gastroscopy

Impairment of colics - coloscopy, USG, sternal puncture – impaired Hb synthesis, basophilic stippling

in 7/2014 blood lead 800 $\mu\text{g/l}$, uro + coproporphyrins, ALA increased

Treated with antidote, decrease to 283 $\mu\text{g/l}$



Intoxication from a lead-based paint – children room

Mother 235 $\mu\text{g/l}$ – not treated

2 daughters – examined in 7/2014
and 8/2014, then treated

daughter 4 years

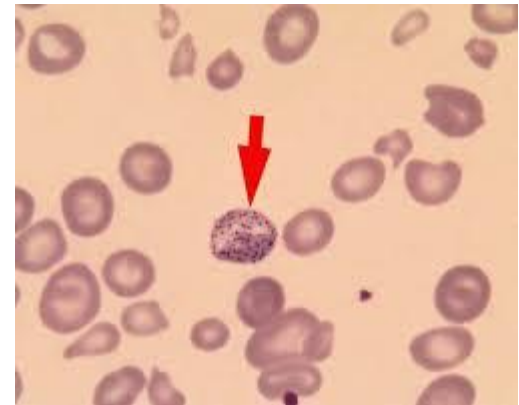
blood lead 348 $\mu\text{g/l}$ 356 $\mu\text{g/l}$

after DMSA therapy 69 $\mu\text{g/l}$

daughter 2.5 years

blood lead 233 $\mu\text{g/l}$ 240 $\mu\text{g/l}$

after DMSA therapy 78 $\mu\text{g/l}$



Safe blood lead level for children is unknown

Mercury



1. Inorganic mercury



- **Exposure:** thermometers, barometers, batteries, electrolytic production of chlorine
- **Ingested poorly absorbed – only diarrhoea**
- Mercury vapor **well absorbed after inhalation, esp. chronic**
- Elimination slowly, **cumulative poison - half-life is 60 days.**
- **Mercury droplets must be carefully removed!**



Laboratory

- Absorbed Hg slowly eliminates by urine, half-life is about **60 days**
- **(easy to accumulate)**

Biological material:

- urine
- **blood**

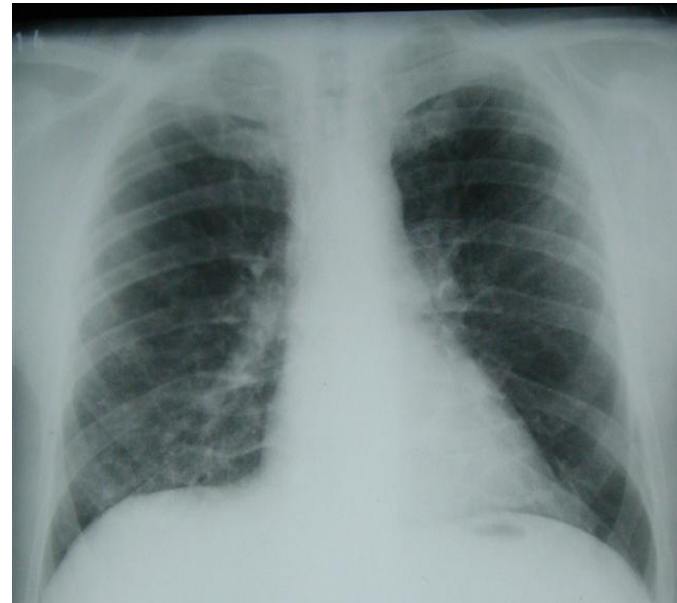


Acute exposure to vapours



Inhalation of high concentration of mercury vapours in a small space:

- **LOCAL EFFECT** - irritation and inflammation of airways, chemical pneumonitis, lung oedema
- – **NOT A SYSTEMIC INTOXICATION** (no neuro and nephrotoxicity)

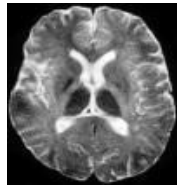
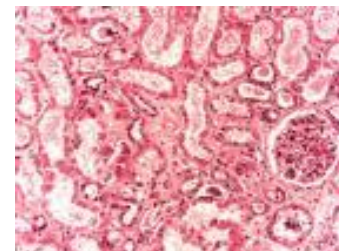
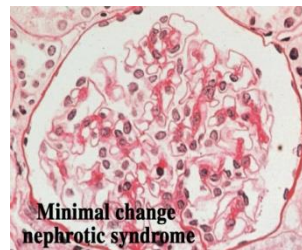
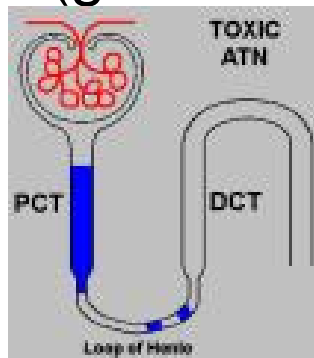


Chronic Hg vapours inhalation

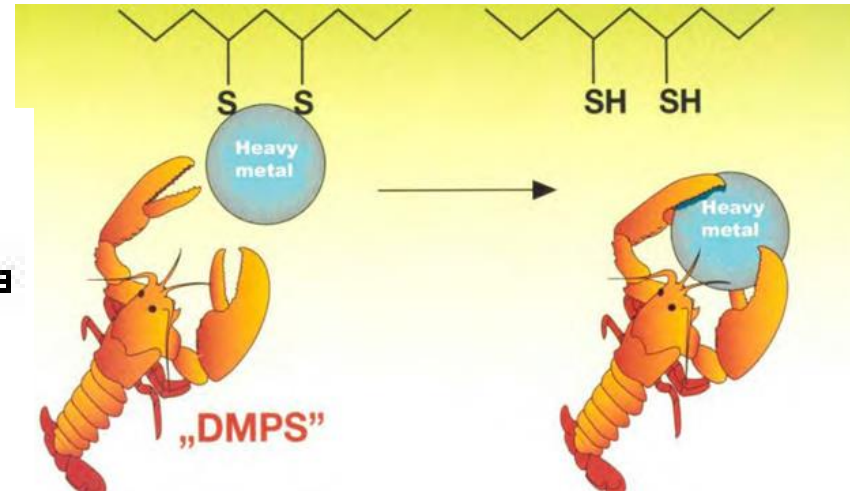
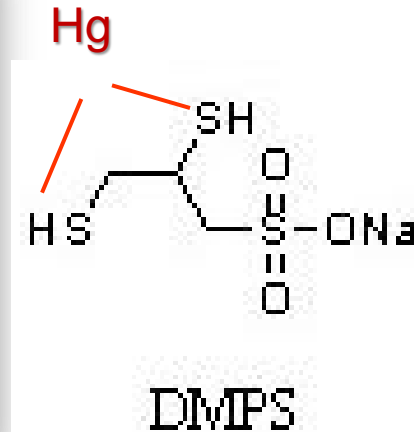
Pathogenesis: Hg oxidized through catalase to Hg^{2+} , binding to SH groups and thus interfering with numerous cellular enzyme systems, readily crosses the blood-brain barrier.

TRIAS:

1. gingivitis
2. tremor – *hatters' shake* (deposit of Hg in basal ganglia and cerebellum)
3. erethism – *mad as a hatter* - hostility, nervousness, inversion of sleep pattern
4. polyneuropathy - EMG
5. kidney damage (glomerulus – nephrotic syndrome and prox. tubule)



Chelating antidote unithiol -DMPS



- **Therapy:** chelating antidote
- DMPS = unithiol - dimercaptopropan sulfonate (Dimaval) cps., inj.
- **Laboratory:**
- Hg in urine or **blood** (acute poisoning)

Tremor in Hg intoxication inorganic salt in skin cream

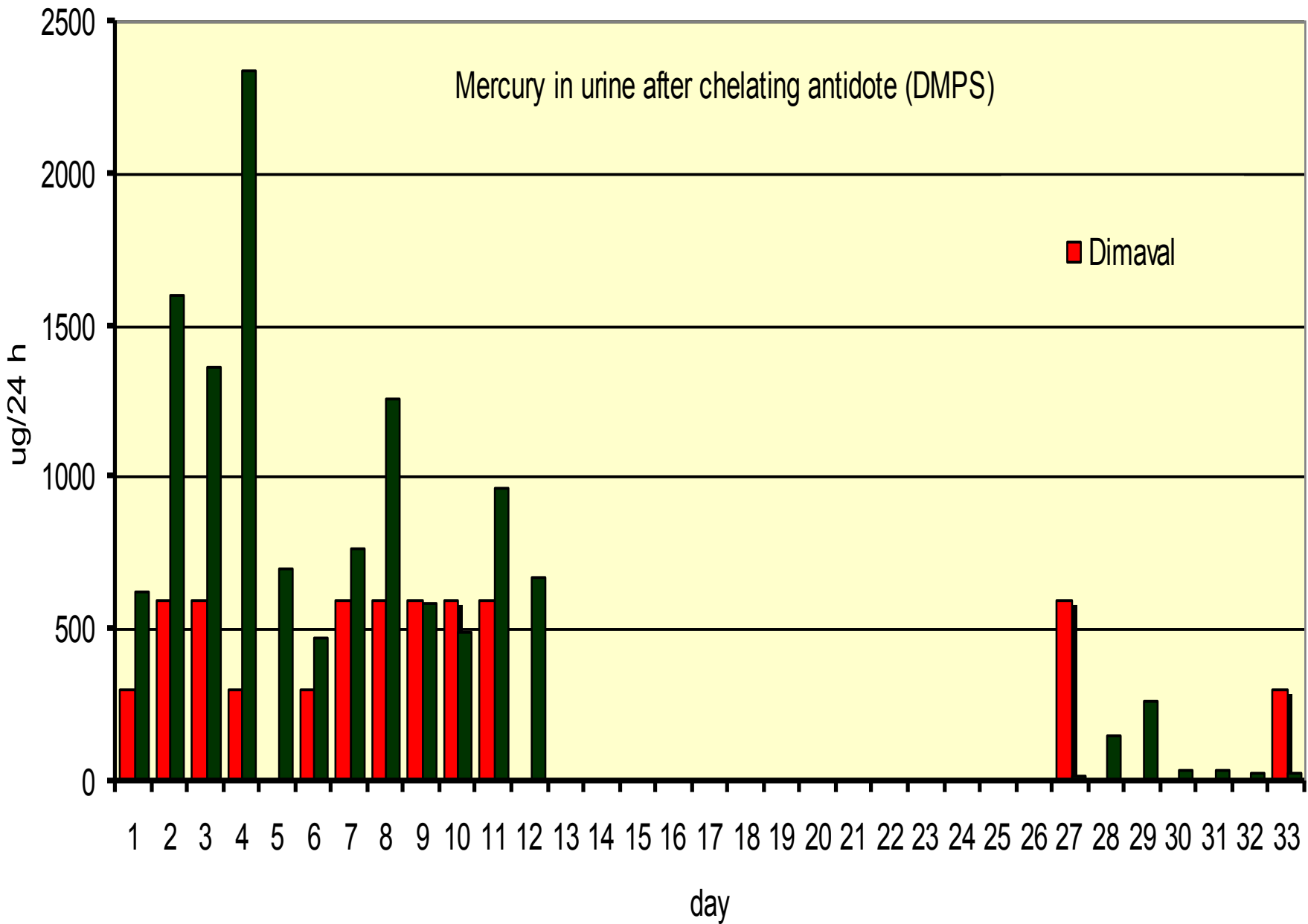


Tomás Tomás
Tomás^v Tomás^v
Tomás^v Tomás^v

Mercury intoxication in 21 y-o student



- 10% $\text{Hg}^{2+}\text{NH}_2\text{Cl}$ skin cream, 4 g Hg in 3 weeks
- skin absorption
- Tremor of the extremities,
- Erethism - Sleeping pattern reversal, depression, anxiety, symptoms resembling schizophrenia
- Kidney damage - Nephrotic syndrome, hypertension
- Polyneuropathy - extreme tiredness, paresthesias, pain, inability to walk
- Weight loss 20 kg
- After 2 months poisoning suspicion
- Call to the Toxicological Information Centre
at the Dept. of Occupat. Medicine. Hg in urine measured



Family exposure

4 members

Hg vapours during cleaning the carpet
found at the container

After unsuccessful cleaning
the parents develop symptoms

Irritation of the airways – cough, fever,
wheezing

Gingivitis

Tremor

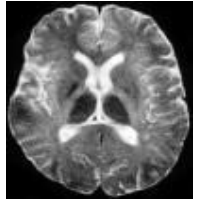
Erethism

Treated with DMPS



2. ORGANIC MERCURY compounds

- **Exposure:**
- phenylmercury - consumption of grain treated with fungicides in Iraq
- methyl mercury - in 1953 in the fish of Minamata Bay
- **Pathogenesis:** accumulate in the **CNS**



2. ORGANIC MERCURY compounds

- **Symptoms and signs:** paresthesias, ataxia, dysarthria, hearing loss, „tunnel vision“
- **Laboratory:** mercury in urine, in blood
- **Treatment:** newer chelating agents (DMSA, DMPS)