

جَائِزَةُ الْخُسَيْنِ
بْنِ عَبْدِ اللَّهِ الثَّانِي
لِلْعَمَلِ التَّطَوُّعِيِّ

AL HUSSEIN BIN ABDULLAH II
AWARD FOR VOLUNTARY WORK



النادي الطبي
Medical Club



Forensic Medicine



Subject: Forensic

Group no: A4

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هَذَا خَلَقَ اللَّهُ فَأَرْوَنِي مَاذَا خَلَقَ الَّذِينَ مِنْ دُونِهِ بَلِ الظَّالِمُونَ فِي ضَلَالٍ مُبِينٍ

lead poisoning

- first of all lets identify

~ "what's lead?" ~



Lead: is a soft, malleable, corrosion resistant element, that has a bluish-white color, with symbol Pb that originates from the latin word (Plumbum) Atomic number 82 (عدد البروتونات = نواة الذرة)
 كما نستخدمها لثقل برصم. مكوّن (Metal)
 وهذا الاسمي بعيننا من ناحية الطب الشرعي بـ :

~ elemental Analysis ~ to detect the element existence in tissues, bullets, environ. samples... etc

- و طبقا الى Lead is a heavy metal "very dense"
 الى عدة استخدامات, كونه في خزائن على نقيض منها صيانت, منها :

- Lead-Acid Batteries used to charge السيارات والتليفونات

- Paint production

- in hospital radiology rooms as a radiation shielding
(in protective aprons, x-ray machines, nuclear reactors, ...)

- As it's a corrosion resistant agent it's used in:

↙ a) Making water Pipes

✓ b) lining tanks that stores a corrosive liquids, ex: Sulfuric Acid

✓ c) Covering some wires & Cables to protect them from corrosion

Compounds

↙ it has many compounds, MC is the oxidation state [and there's many subforms of it $\begin{matrix} \text{II} \\ \text{IV} \\ \text{II, IV} \end{matrix}$], red lead^{III}

lead salts [acetate, nitrate, phosphate], Lead sulfide,^{*}

Organolead Compounds as: ✓ Tetra-ethyl lead^{*}

وتمامه الباقي ابي معروضي بالسلايد ...

Lead Crisis

هو في هذا أختلة على الـ lead crisis صارت كروب على بلدان مختلفة

2014
فلينت واتر كريسيس / كاي بوي / مصر / سوريا / غزة

صار في تاكسي
للأنايب التي

فتسرب فيها الـ lead
لا فتضره إلا الناس
خامسة الأطفال

هو بلستي

lead mining
since early
20th century

فصارت ودرق
من أكثر أخصب
الملوثة بالعالم

له هو كمانو يستخفون

أدوات متفجرة وأسلحة

تسوي على الـ lead

فكانت تعمل

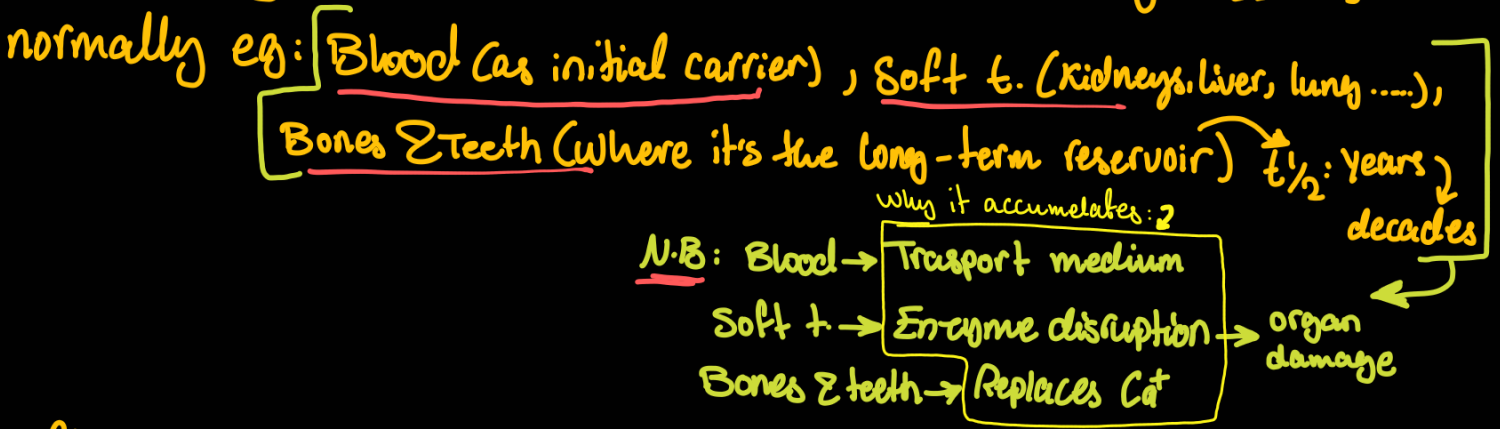
Soil & water Contamination

↓
chronic exposure → Neuro.,

renal & developmental

damage

* usually lead persist in human body tissues



after being inhaled, ingested, or Absorbed, tho the latest is rare

until it reaches the toxic dose that causes poisoning, and this's known as: Cumulative poisoning

The slide sums-up lead poisoning ٥٥ كيف يدخل! *
شوائب في *
بأثر على *
Forensic significance *

* هذا الـ Metabolism تباه :

١ قلنا انه الـ initial carrier تباه هو (الدم) الـ $t_{1/2}$ تباهه (٢٥-٣٠٠) ٢٥-٣٠٠
اي هو بفضولي الـ $t_{1/2}$ تباه الـ RBC تقريباً (٢٢-٤٢٠) ←

Q Forensic use: Blood lead WL (BLL) is the standard for Dx recent exposure

٢ بـ الـ $t_{1/2}$ تباهه من ٥-١٠ (roughly 400) قبل م
Shows intermediate (redistributing / being excreted) term exposure في
in urine / faeces

> 90% الـ Mainly in Bones & Teeth

(3) ١- (Skeletal) cc (Marrow) cells, bone marrow, bone marrow

والـ $t_{1/2}$ تكون عكس يصل 254 > (زي م قلنا قبل) $(\frac{yrs}{decades})$

هون بتكون حالة انه فترة كثر طويلة

وعل analysis بيبي انه قد cumulative exposure

* وعضو عكس ينقل لأفك زى: الشعر، العرق، saliva، sweat، breast milk

Toxicity of lead

MOA: it interferes with critical enzymes "Generally"

(A) Disrupts energy production → through targeting the mitochondria, that blocks the oxidative phosphorylation (the process that makes ATP)

⇒ Results in: weak cells specially in energy-demanding organs as brain & kidneys

(B) Blocks ion Pumps: Na^+ , K^+ , Ca^{++} ATPases (the ones that maintain $\bar{e}$ balance & cell membrane stability)

⇒ which results in: disrupting in Nerve signals, Ms. function and cell integrity

(C) Disrupts Haem synthesis: through

① Disrupts heme synthesis: interferes w 2 enzymes

⇒ Result: ✓ Anemia *
 ✓ Fatigue *
 ✓ Neurological Symp. due to $\downarrow$ O_2 delivery

→ Aminolevulinic Acid dehydratase
ALAD → ^{بالوضع الطبيعي يكون ALA} _{prophobilinogen}
 ↳ Result: building-up toxic precursors

→ Ferrochelatase → Normally: inserts iron into protoporphyrin to make heme
 ↳ Result: No functional Hb

② Downstream Eff. on body: cwe it interferes with

- ✓ Cell membrane ✓
- ✓ Vit. D synthesis ✓
- ✓ DNA transcription ✓

(Possible Pathways...)

1st Page ✓

2nd p. → Occupational expo. "من جهة الناس المعرضة لخطره"

Acute Poisoning

- Acute poisoning is ^{very} rare and usually results from ingesting large

doses of soluble lead salts especially lead acetate.

Lethal doses:

- Most lead salts: ~10 g per 70 kg adult
- Tetraethyl lead: ~100 mg/kg

• **Fatal period:** Death may occur within 1–3 days depending on dose and treatment.

از پیرفوس الی MSA ای
حکینها فوقه و از قطع
علیه الاعراض هائی

System	Symptom	Explanation
✓ Mouth	<u>Metallic</u> astringent <u>taste</u>	<u>Direct</u> chemical <u>irritation</u>
✓ GI tract	Vomiting, <u>colic-like</u> abdominal pain	Lead irritates mucosa and smooth muscle
✓ Bowel	<u>Constipation</u> or <u>purging</u> ; black <u>offensive</u> <u>feces</u>	Lead forms <u>lead sulfide</u> in gut
Urinary	<u>Suppressed</u> <u>urine</u> <u>output</u>	Kidney damage
Muscles & Joints	Leg cramps, arthralgia	<u>Electrolyte imbalance</u> and inflammation
Systemic	Collapse before death	Multi-organ failure due to toxicity

لانہ قلنا انه بآثر علی الیون پمپس

✱ • Tt • 2

only effective if performed within the 1st hour after ingestion → بعد هیکت بلوے صافا پی دند

Step	Intervention	Purpose
<u>1. Emesis</u>	Induce vomiting	Remove unabsorbed lead
<u>2. Gastric lavage</u>	With magnesium/ sodium sulfate	Precipitate lead as insoluble salts
<u>3. Calcium gluconate</u> protective competition	Stabilize membranes, reduce absorption	Competes with lead for binding sites
<u>4. Chelation therapy</u>	oral IV IM <u>DMSA, EDTA, BAL,</u> <u>Penicillamine</u>	Bind lead → excrete via <u>urine</u>

Lead > B
absorbed

- Aspiration pneumonia
- Mech. injury to esophagus/stomach
- Electrolyte disturbance

↳ Mnemonic: ECG

✍

- Will let's move to the chronic part of lead poisoning...

↳ Unlike Acute poisoning, chronic poisoning develops slowly over time → cure at repeated low-lvl exposure → ne msk vshl vso
3 ways of how does it develop

① Environmental

- Drinking polluted water
- Food Contamination

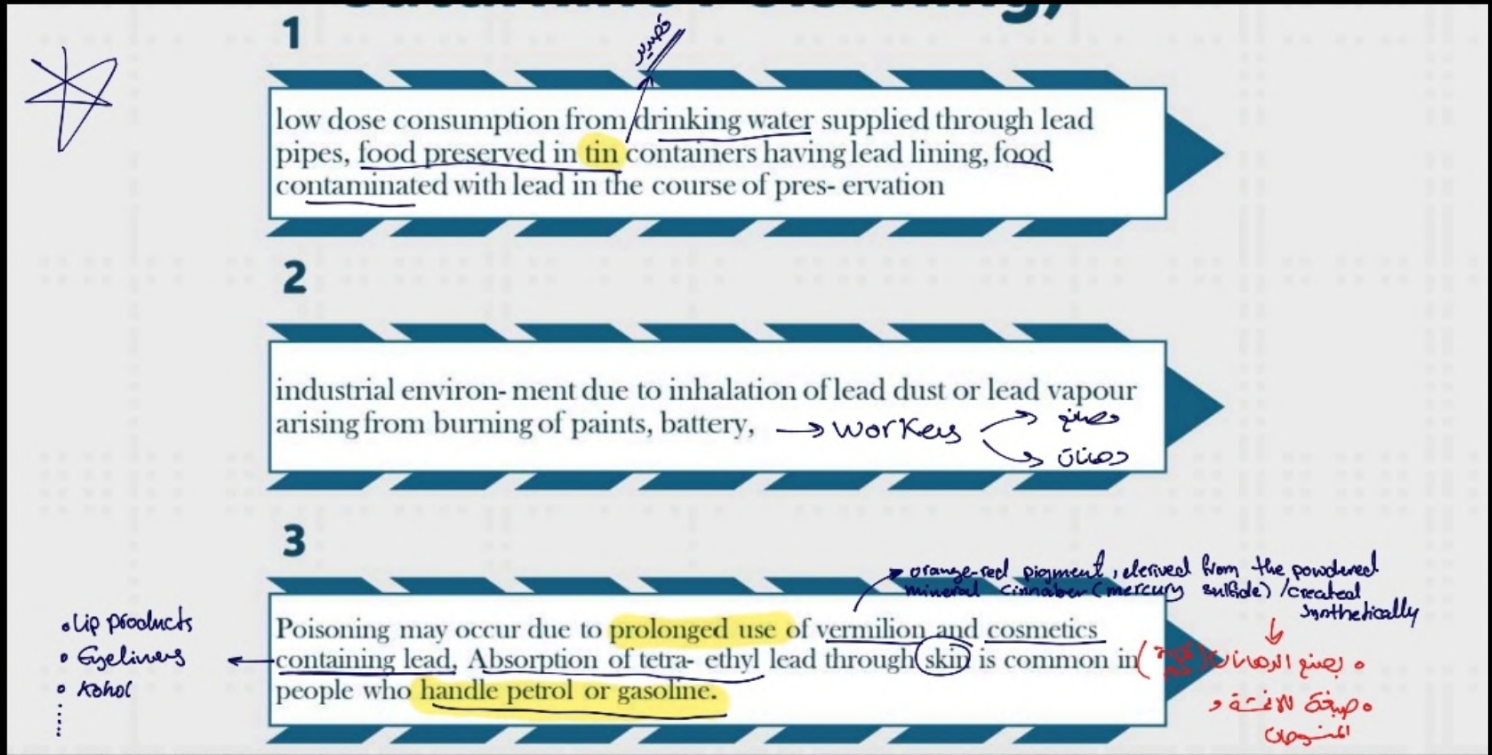
في
الماء

② Occupational

في العمل

③ cosmetic

/Absorption via skin



Clinical features

Lead is a heavy metal
it mimics Ca^{2+} and
interferes w enzymes,
ion channels and
cellular processes
across multiple systems

↳ logic

① Brain

- Adults → Headache, memory loss
- Children → Encephalopathy, mental deterioration
↳ MC caused by tetraethyl lead

cause it can cross the BBB and $\times$ the monoamine oxidase and disrupts NT →
↳ via binding w SH radical (sulfanyl radical)

- ✓ cognitive decline
- ✓ seizures
- ✓ coma

② Gingiva → cause Burtonian line

seen in poor dental hygiene in >50%
it is a classic sign of chronic exposure
subepithelial lead sulfide ↓
impairment in synthesis of haem

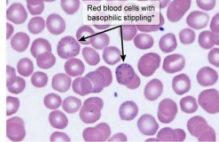
highly reactive intermediate

③ Blood

- ✓ **Anemia:** Lead inhibits ALAD and ferrochelatase → impaired heme synthesis
↳ prothymoglobulin (ALA) ↓ U.S.S. : Normally → when X: building-up toxic precursors
- ✓ **Basophilic stippling:** Aggregates of RNA in red cells due to

interfering w 2 enzymes → Anomalous and dehydrated (ALA) → inhibition → Result: building-up toxic precursors → Ferrochelatase





mitochondrial damage

④ Peripheral Nerves → "lead palsy" → Late sign

• Demyelination: Slows nerve conduction

• Clinical signs: Wristdrop, footdrop (lead palsy) → Mostly the extensor M. are affected

Neurological signs due to PbO₂ chelation

5. Kidneys

- Chronic tubulointerstitial disease: Lead damages renal tubules → proteinuria, nephropathy

6. Gastrointestinal Tract

- Colic: Spasmodic abdominal pain due to smooth muscle irritation

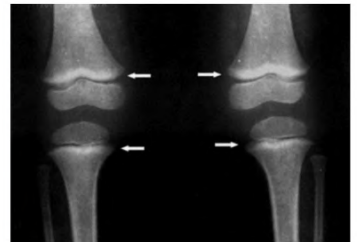
→ and this's an early sign of poisoning

associated w/ constipation

7. Bones

• Children: Radiodense metaphyseal bands due to lead deposition beyond epiphysis

- Mechanism: Lead replaces calcium in growing bones; promoted by vitamin D & Ca²⁺



as form of ↑ density ← Radio Ex. ← وبين ←
at the metaphyseal
plate of growing long bone

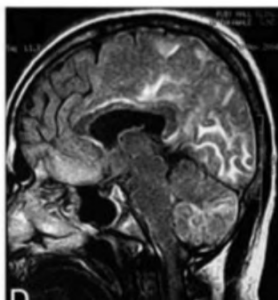
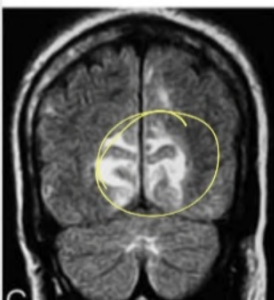
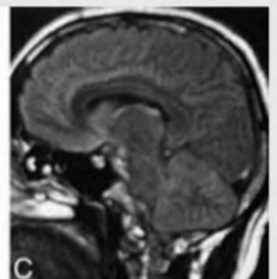
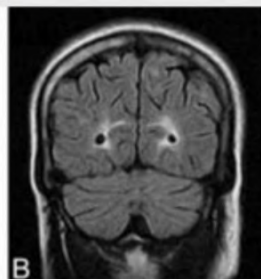
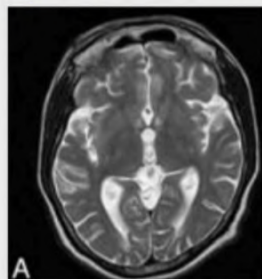
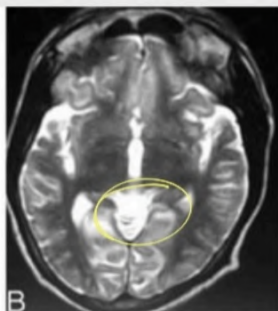
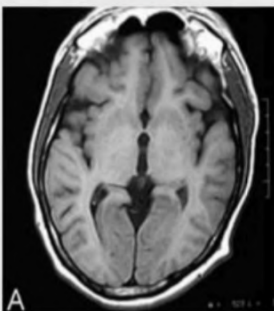
• Facial Pallor (early), due to vasospasm of capillaries

• special medicines (DMSA, EDTA, BAL, Penicillamine) → (Sgt. not able to remove lead at all, urine is)

Prechelation MR imaging

After TE features of JS are clearly improvement JS

Postchelation MR imaging



vis is o Abnormalities ②
↓ apt
basal Ganglia ②
→ Appears as a hyperintense area
suggests that lead

- Retinal stippling. → Tiny dark spots on retina } May indicate chronic exposure specially in children / highly exposed ppl
Small BVs of retinal cells
- Effects on Circulatory System.
 ↳ interferes w RBCs production
 ↳ Fetusparms → facial pallor
- Effects on Reproductive System.
 ↳ ♂: Reduces sperm count & motility
May cause infertility
 ♀: balance
↑ risk of miscarriage & fetal developmental problems

Transplacental transfer
 و يتأثر على الجنين

Diagnosis

Dose dependent toxicity

- **Blood investigations:** 3.5 µg/dL: Numb.
15 µg/dL: Adults
Safe level
 - Normal range of level of lead is 0-50 µg/dL !!
 - Anaemia and basophilic stippling.
 Q: What's the forensic importance of this?
 BLL (Blood lead lvl) is standard for Dx recent exposure
- **Urine investigations**
 - Lead above 100 mg/L.
 - Aminolaevulinic acid (ALA).

Pb ²⁺ Level	Effects
0-10 µg/mL	Developmental toxicity, ↓ IQ, ↓ hearing, ↓ growth, fetal effects via placenta
20 µg/mL	↓ nerve conduction, ↑ erythrocyte protoporphyrin, altered vitamin D and calcium metabolism
40 µg/mL	↓ hemoglobin synthesis
50-100 µg/mL	Colic, frank anemia, nephropathy, encephalopathy
150 µg/mL	Death

- **X-ray examination** ✓ Detection of radiopaque lead-containing material (reveal ingested lead obj)
 ✓ localizing retained lead ✓ Monitoring clearance
- Abdominal X-ray
- X-ray of the long bones → hyperdense lesion in metaphyseal plate

Management

- **Chelating agents** need to be administered depending upon the indications as written earlier. ✓

↳ Notes as

- Chelation is recommended for :

Children → blood lead levels are >55 µg/dL

Children -> blood lead levels are $> 55 \mu\text{g/dl}$.

- Adults -> blood lead levels exceed 80 mg/dl or if these levels exceed $(60 \text{ mg/dl}$ and symptoms) have developed.

Medicolegal Aspects

- Children often have a craving for eating inedible things such as mica and often lick lead-based flakes of lead paints. →
• Art projects
• Crafts
• Cosmetics
• natural minerals
• higher absorption & developing systems
- Infants may suffer from slow and progressive lead poisoning by imbibing lead secreted in the milk of the mother.
• still (يحيى)
- Suicidal and homicidal uses are very rare.
• فكيه
• فكيه
• الامراض على
- Lead may be used criminally as an abortifacient.
• abortion

• Autopsy Findings •

- ↳ changes in CNS req: • cerebral edema
• atrophy
- ↳ presence of various t. & organs
- ↳ Microscopic changes: - Basophilic stippling in RBCs

