

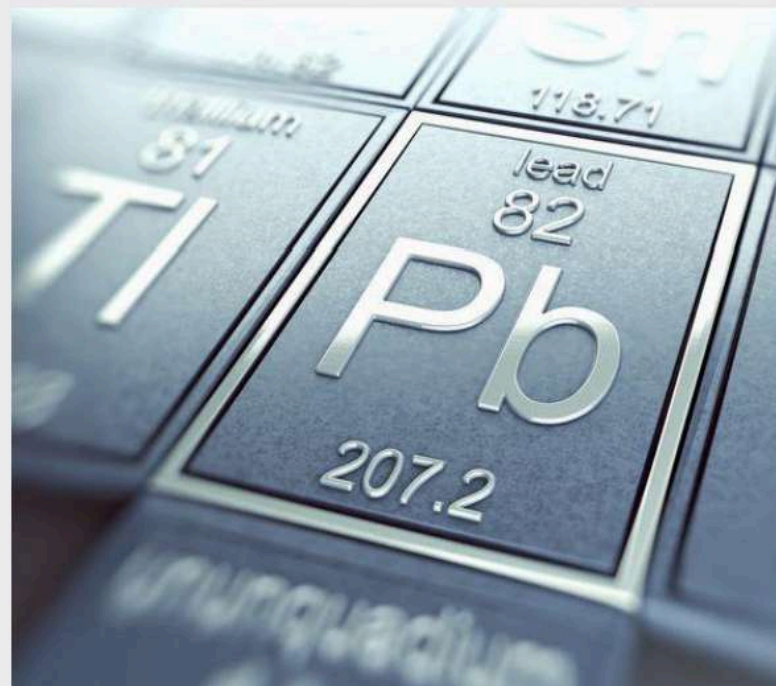
Lead Poisoning

Rama sawafta & Noor thalji



What is lead

- Lead is a **chemical element** with symbol **Pb** and atomic number 82.
- It is a dense, **heavy metal**.
- Lead's chemical symbol - Pb - comes from the Latin word **plumbum**.



Description

- Lead is a bluish-white metal of bright luster.
- Lead is a soft, malleable and corrosion resistant material.

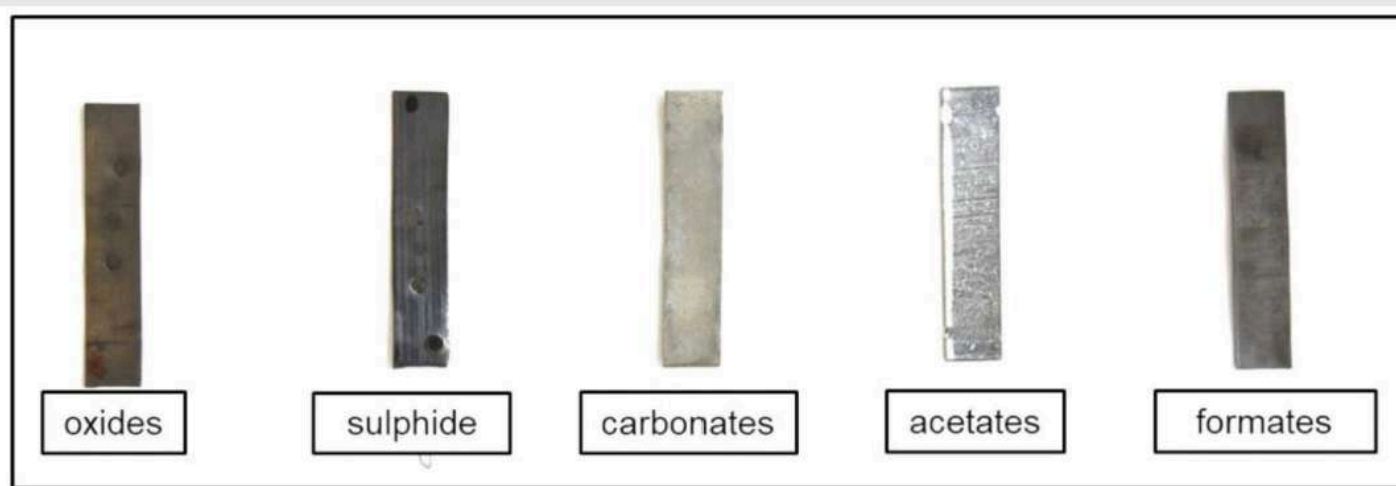


Uses

- making **water pipes**, some of which are still in use today.
- lining **tanks** that store corrosive liquids, such as sulfuric acid.
- shield against X-ray and gamma-ray radiation and is used in X-ray machines and nuclear reactors.
- covering on some wires and cables to protect them from corrosion.
- Most of the lead used today is used in the production on **lead-acid storage batteries**, such as the batteries found in automobiles.
- Production of **paint pigments**.

Compounds

- Lead acetate
- Lead carbonate
- Lead tetraoxide
- Lead sulphide
- Lead oxide
- Lead oleate
- Tetra-ethyl lead



Lead Crisis

- Iraq War and the Syrian Civil War, the use of lead-containing ammunition and explosives can lead to contamination of soil and water, posing health risks to local populations.
- Gaza Strip
- Kabwe lead pollution- began during the early 20th century
- Flint water crisis -2014

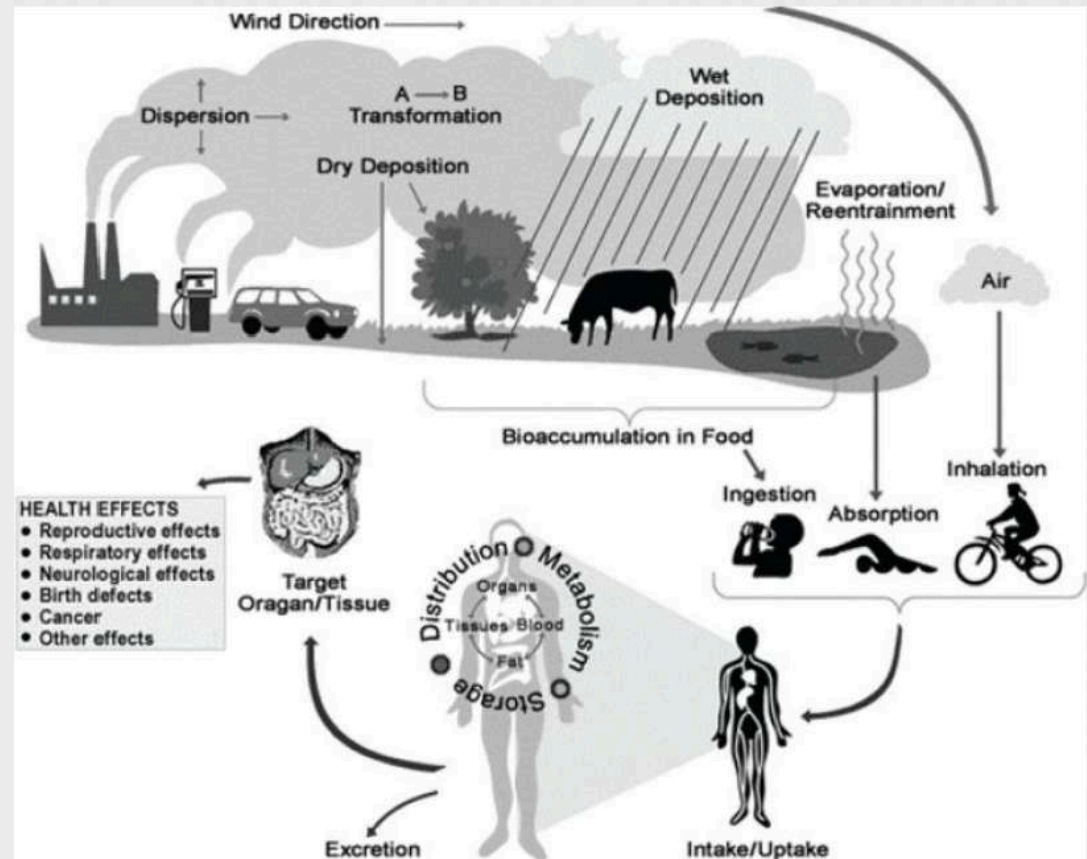


Properties of the element

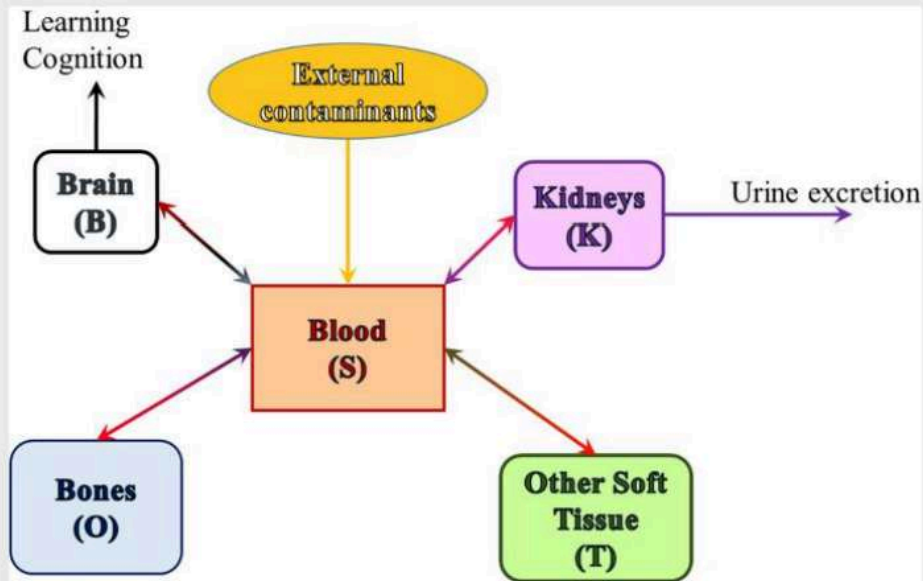
Lead is normally present in almost all human tissues.

Lead and its **compounds** are **toxic** and are retained by the body, accumulating over a long period of time, a phenomenon known as :

cumulative poisoning, until a lethal quantity is reached.



Lead poisoning



- Tops the list of heavy metals as far as the chronic poisoning is concerned
- **Plumbism/saturnism** : chronic Lead poisoning
- Elemental lead and inorganic lead compounds are absorbed through ingestion, inhalation or absorption.

Metabolism

- In the **blood**, about 95-99% of lead is sequestered in red cells, half-life (25 days).
- The largest proportion of absorbed lead is incorporated into the **skeleton**, which contains >90% of the body's total lead burden, half life (>25 years).
- Lead half life in **soft tissues** is about 40 days.
- Lead is excreted mainly in the urine and in the faeces.
- Lead also appears in hair, nails, sweat, saliva and breast milk.

Toxicity of lead

- Lead interferes with **mitochondrial oxidative phosphorylation** and sodium, potassium and calcium **ATPases**.
- Lead depresses the enzymes responsible for **haem synthesis** :
 - blocking the enzyme aminolaevulinic acid dehydrase
 - inhibits ferrochelatase

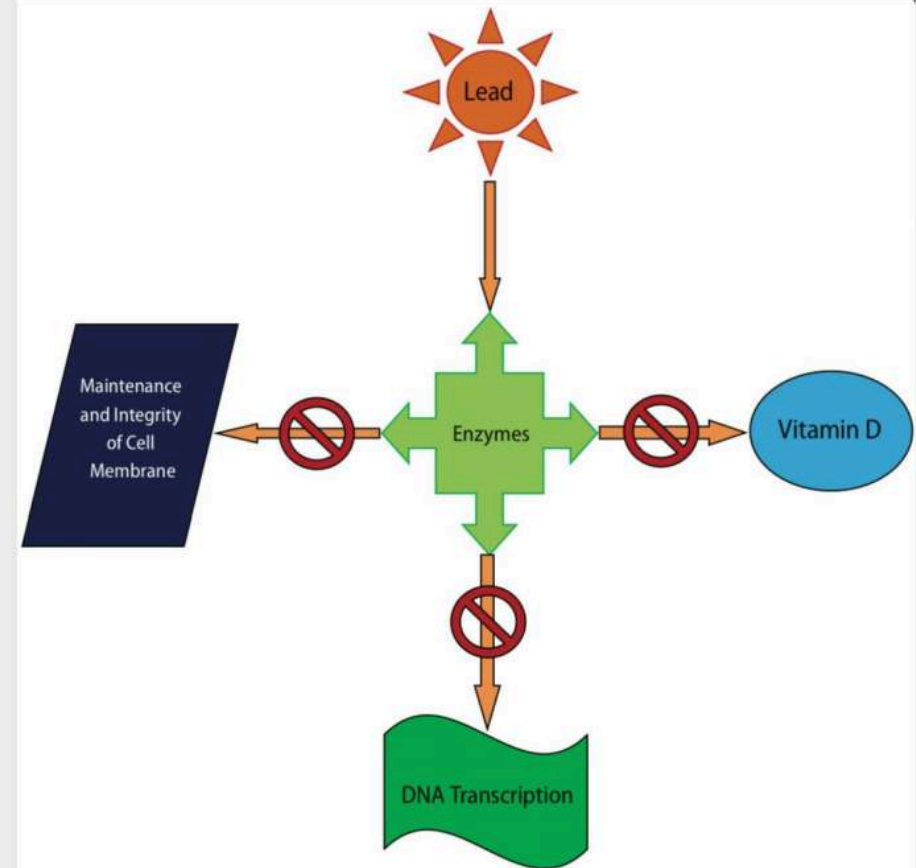


Figure 3. Illustration of the action of lead on enzymes, leading to the disruption of vitamin D synthesis, maintenance of cell membrane and DNA transcription.

Possible pathway of lead poisoning

- Poisoning due to lead occurs mainly by ingestion of food or water contaminated with lead.
- Accidental ingestion of contaminated soil, dust or lead based paint.
- Lead toxicity may be caused through fruits and vegetables contaminated with high lead levels from the soils where they were grown.
- Lead from water pipes coming into homes is one of the major sources.

Possible pathway of lead poisoning

- Occupational exposure :

radiation shields, ammunition, certain surgical equipment, developing dental X-ray films prior to digital X-rays, fetal monitors, circuit boards, jet engines, and ceramic glazes, **lead miners and smelters**, **plumbers and fitters**, car mechanics, glass manufacturers, construction workers, **battery manufacturers and recyclers**, firing range instructors, and plastic manufacturers are at risk for lead exposure.

Acute Poisoning

- It is very rare, the only common soluble salt is the acetate and this is dangerous only in large doses.
- The average lethal dose is said to be 10 gm/70 kg for most lead salts, while it is 100 mg/kg for tetra-ethyl lead.
- Fatal period may extend to 1-3 days.

Acute poisoning – symptoms

- **Metallic astringent taste** in the mouth
- **Vomiting** associated with **colic-like pains** in abdomen.
- There may be purging, more usually **constipation**.
- The faeces are offensive and black due to formation of lead sulphide and the urine is suppressed.
- Cramps in legs and **arthralgia**.
- Collapse precedes death.

Management

Emesis

**Gastric lavage
with magnesium
or sodium
sulphate**

**Calcium
gluconate**

**Chelating agents
:
DMSA, EDTA, BAL,
Penicillamine**

Chronic Poisoning (Plumbism, Saturnism or Saturnine Poisoning)

1

low dose consumption from drinking water supplied through lead pipes, food preserved in tin containers having lead lining, food contaminated with lead in the course of preservation

2

industrial environment due to inhalation of lead dust or lead vapour arising from burning of paints, battery,

3

Poisoning may occur due to prolonged use of vermilion and cosmetics containing lead, Absorption of tetra-ethyl lead through skin is common in people who handle petrol or gasoline.

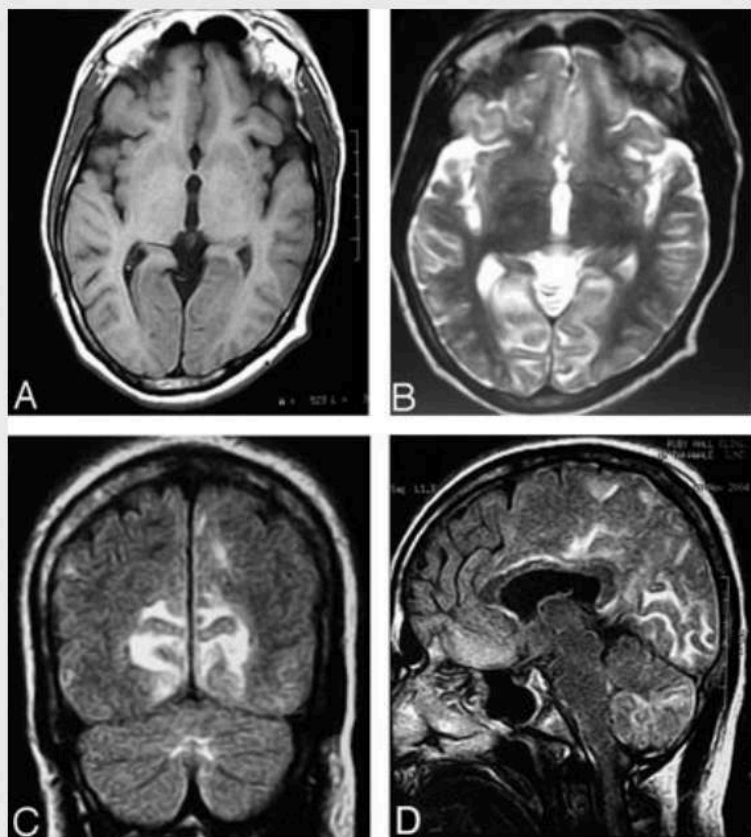
Clinical Features

- Facial Pallor (early), due to vasospasm of capillaries
- Colicky pain (early)
 - characteristics: spasmodic, intermittent and relieved by pressure, associated with constipation
- Lead palsy (late):
 - Lead induced peripheral demyelination is reflected by pro- longed nerve conduction time and subsequent paralysis, usually of extensor muscles of the hands and feet (wristdrop and footdrop).

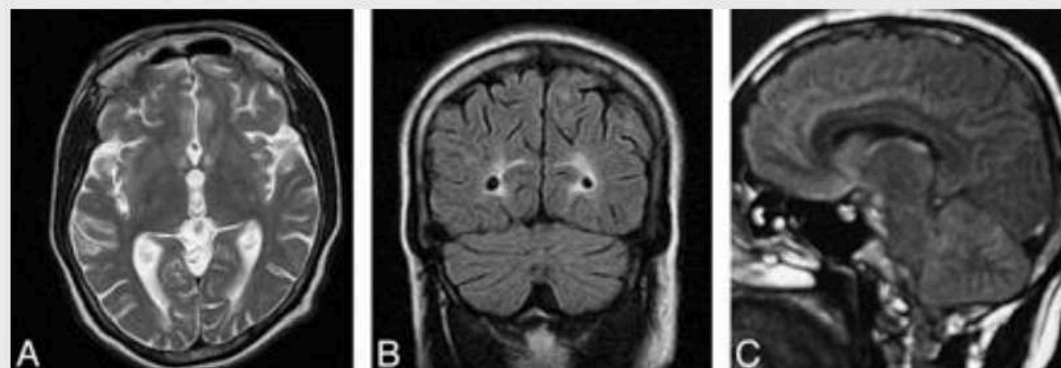
Clinical Features

- Lead Encephalopathy :
 - more common in poisoning by **tetraethyl lead**.
 - it is frequently encountered in children.
 - this may be due to inactivation of monoamine oxidase due to combination of lead with the **SH** radical of the enzyme.
 - causes changes in personality, convulsion, delirium and coma.

Prechelation MR imaging



Postchelation MR imaging

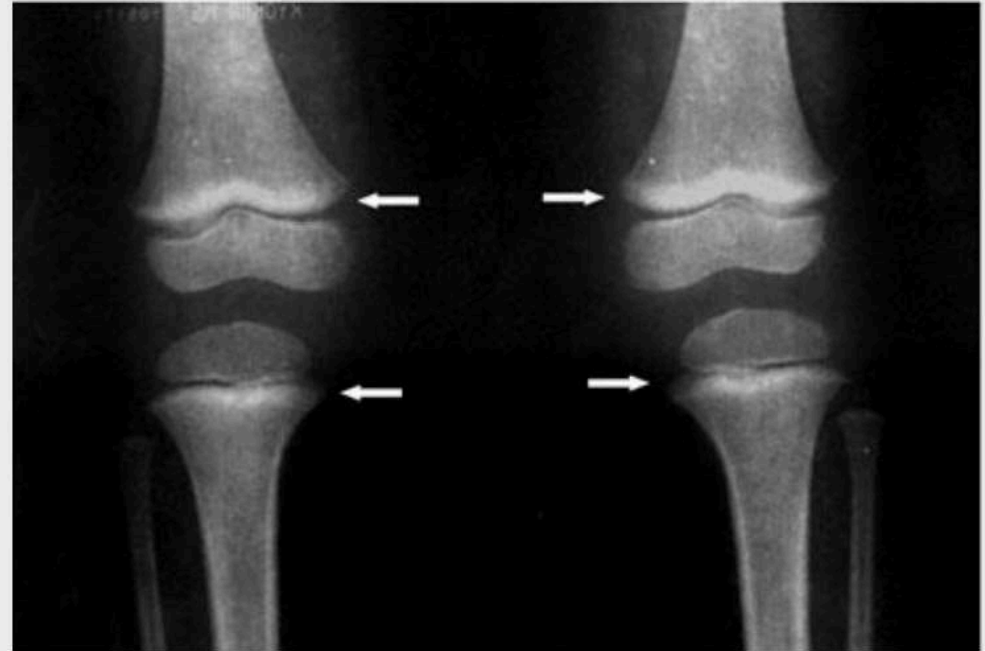


Clinical Features

- Lead osteopathy:

-In children, lead is deposited beyond the epiphysis of the growing long bones.

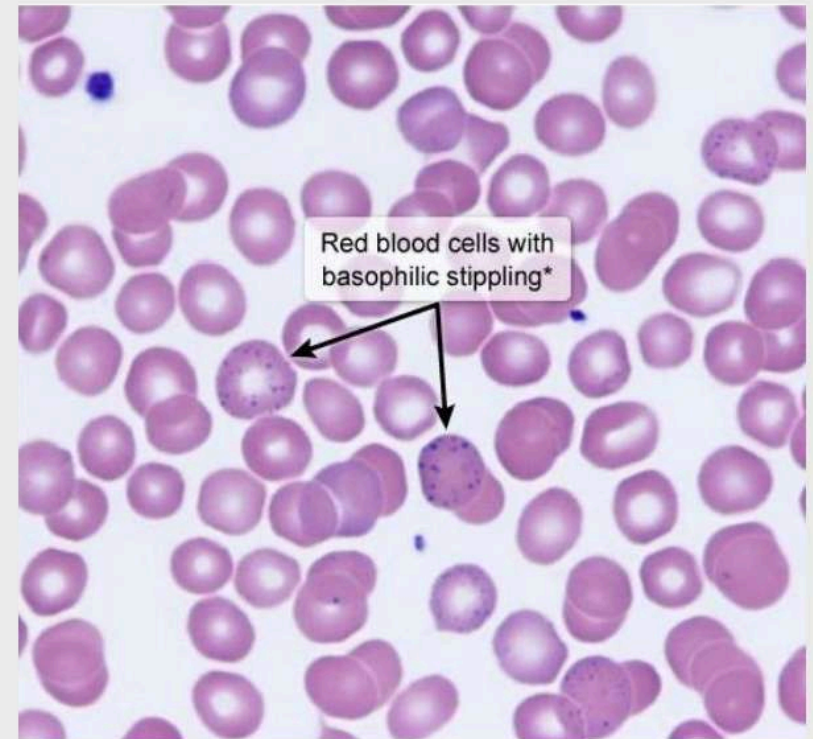
The deposition is promoted by calcium and vitamin D and is detectable by radiological examination in the form of increased density at the metaphyseal plate of growing long bones.



Clinical Features

Anaemia with Punctate Basophilia:

- It is due to impairment in the synthesis of haeme from protoporphyrin and of porphobilinogen from δ -aminolaevulinic acid.
- The **basophilic stippling** of the red cells is due to condensation of iron containing ribonucleic acid near the mitochondria.



Clinical Features

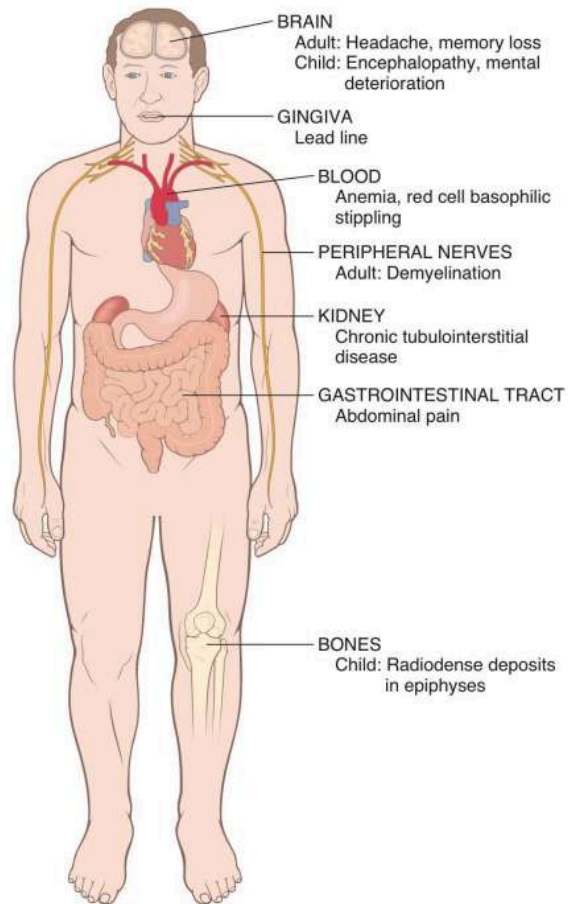
Lead line or **Burtonian line**:

- Is a bluish-black discolouration due to **subepithelial deposition** of lead sulphide granules on the gums at the junction with the teeth.
- It is seen in not more than 50% of cases, in whom dental hygiene is poor.



Clinical Features

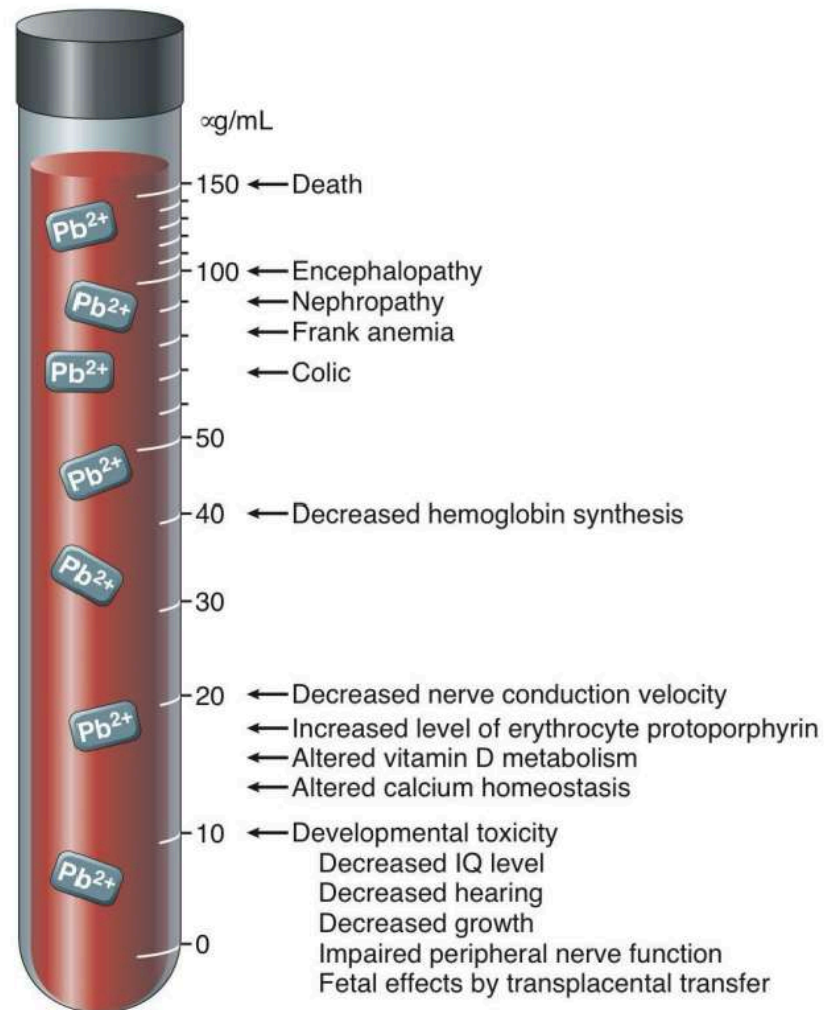
- Retinal stippling.
- Effects on Circulatory System.
- Effects on Reproductive System.



SOURCES

OCCUPATIONAL
Spray painting
Foundry work
Mining and extracting lead
Battery manufacturing

NONOCCUPATIONAL
Water supply
Paint dust and flakes
Automotive exhaust
Urban soil



Diagnosis

- **Blood investigations:**

- Normal range of level of lead is 0–50µg/dl.
- Anaemia and basophilic stippling.

- **Urine investigations**

- Lead above 100 mg/L.
- Aminolaevulinic acid (ALA).

- **X-ray examination**

- Abdominal X-ray
- X-ray of the long bones

Management

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

- Chelation is recommended for :

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

Adults -> blood lead levels exceed 80 mg/dl or if these levels exceed 60mg/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.
- Infants may suffer from slow and progressive lead poisoning by imbibing lead secreted in the milk of the mother.
- Suicidal and homicidal uses are very rare.
- Lead may be used criminally as an abortifacient.

Autopsy Findings

- Changes in the central nervous system, e.g : cerebral edema, atrophy.
- Presence of lead in various tissues and organs, especially bones, liver, and kidneys.
- Microscopic examination may reveal characteristic changes such as basophilic stippling in red blood cells.

Test yourself 😊

This X-ray image depicts a marked increase in the radiodensity of the epiphyses, resulting from impaired remodeling of calcified cartilage in the wrist epiphyses.

- What causes this condition?
- What is the proper management?



Test yourself 😊

- 1) In the context of lead poisoning, **name this sign.**
- 2) Describe the significance of this sign in the diagnosis of lead poisoning and how it appears on physical examination.



**Thank you for your
active listening**