

A Review of Lead Toxicity
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Abstract:

Toxicity of Metals is the Toxic effect of certain metals in certain forms and doses on life. Toxicity is a function of solubility. Insoluble compounds as well as the metallic forms often exhibit negligible Toxicity. Human beings come in contact with metals in their day to day life by using things made up of metals.

Lead is one of the metal which is used in many ways in our day to day life. Ink, toys, clay, pencils, cosmetics, hairdye, paints are made by using lead compounds. Because of this extensive and continuous use of lead, its levels are increasing in our body and in environment. So this is necessary to avoid exposure and prevention of lead toxicity. People should aware about this. Lead Toxicity study regarding- measures that helps in avoiding contact of Lead, early diagnosis of Lead poisoning, Laboratory tests to detect Lead in our body, Sign Symptoms and Treatment of Lead are studied from Modern Texts of Toxicology and discussed here.

Keywords: Lead, Compounds, Uses, Toxicity.

Introduction:

Lead is one of the Metal which is in close contact with us. In our early life when we write our first alphabet on paper since then we came in contact with Lead as we use pencil for writing. Rather it's better to say that we came in contact with lead even before this age of start writing, when our parents gave first Toy to us, colored with lead compounds. Lead is used for Car batteries, cable sheathing, weights for lifting, Paints used for Homes, Furniture, Toys, Schools, Offices, Water pipes in old houses, Canned foods, Soil, Ceramics, Eyeliner *Lipstics* Cosmetics some *jewellery* etc. The street food like *Vadapaav*, *Samosas*, *Pattice* are wrapped with newspaper. In fast lifestyle people feel easy to get such food while travelling for their offices, at that time Lead from the ink of newspapers stick over the food enter in our G.I. tract. Even in public transport we touch the rods of trains, buses, auto rickshaw while travelling, they are coloured with paints having lead. Due to this close contact of various compounds or forms of Lead, it is of prime

importance to study the Lead toxicity. Hence the topic Lead toxicity is selected for study in this Article. Due to Repetitive and continuous use of lead by human beings its level is rising in our body. Workers working in lead industries, Children, Adults are coming in contact with Lead directly or indirectly.

Lead is not an essential constituent of our body, but it is always present in our body due to its extensive use and easy absorption. Hence Lead is studied through Modern Textbooks of Toxicology. The data compiled, analyzed and presented in this Article.

Materials and Methods: Lead is studied from the chapter of Metallic poisons in Textbooks of Toxicology. They are as-
Textbook of Toxicology by J.P. Modi, Parikh, Apurba Nandy, Dr. K.S. Narayan Reddy. The data is as below:-

LEAD :

- 1) Name of metal- Lead. Symbol – Pb. Atomic number- 82. Crystal-Face-centered Cubic.
- 2) Preparations commonly used—
 - a. Lead acetate: Commonly called as sugar of Lead. Having sweet taste it occurs in white masses looks like loaf of sugar. It was used to sweeten wine in olden days.
 - b. Lead Subacetate: Used in Gouldard's solution.
 - c. Lead Carbonate: Used in painting.
 - d. Lead Tetraoxide : Scarlet crystalline powder used as Vermilion.
 - e. Tetra-ethyl Lead: Used in Petrol and gasoline.
 - f. Lead Monoxide: Used in hairdyes, paints.

- g. Lead Chromate: Used as a pigment, sweetmeat colouring.
- h. Lead Tetra ethyl: Added to petrol as ethyl petrol or ethyl gasoline.

Lead Chloride, Lead Sulphate, Lead Nitrate, Lead Iodide Lead Sulphide are some other compounds.

Lead Toxicity:

Absorption-

- 1) Gastro intestinal Tract- Most Lead compounds are soluble in Gastric juice are thus absorbed through G.I. Tract.
- 2) Respiratory Tract-Lead dust and fumes well absorbed through this way.
- 3) Skin- Lead tetra ethyl, Lead tetraoxide used in cosmetics and dye and can absorbed through Skin.
- 4) On swallowing- Lead acetate is soluble in water and is easily absorbed when swallowed, it is more injurious locally.

Distribution and Deposition- Lead is a Cumulative poison. On exposure, it deposits in tissues, bones, liver and kidneys.

Excretion- Through Urine, slightly through Bile, in a small extent through Nails.

Acute Lead poisoning:

***Fatal dose** –

1. In Adult: Lead acetate 20gm.
2. Fatal period: 24 hrs to 2-3days
3. Lead carbonate 30gm.
4. Lead tetra ethyl 2 drops.

***Signs and Symptoms:**

- a) Metallic taste in mouth.
- b) Burning pain in throat.
- c) Abdominal pain.

- d) Vomiting. Vomitus is curdy white due to Lead chloride.
- e) Loose motions with cramps in abdomen. Black Stool due to Lead sulphide.
- f) Thirst, Dehydration, signs of Collapse.
- g) Death may occur due to cardiac failure.
- h) In Lead tetra ethyl poisoning, the central nervous system is affected, it causes irritability, insomnia, vertigo, tremors, mental excitement.

*** Sub acute Lead poisoning:**

The administration of repeated small doses of a soluble Lead salt such as Lead acetate results in Sub acute poisoning. A blue line on gums and gastrointestinal symptoms present, scanty urine, nervous symptoms are also present. Death though rare but if so may occur from convulsions and coma within three days.

Treatment of acute poisoning –

- 1) Removal of Unabsorbed poison:-
 - a) Stomach wash:- With 1% solution of Magnesium or Sodium sulphate, then with plain water to remove Lead sulphate formed, also give purgation with sodium or magnesium salt.
 - b) Calcium gluconate 2 gms IV-To relieve colic pain and to help deposition of some lead in bone to prevent crisis. c) Atropine may be given for colic pain.
- b) Elimination of absorbed poison:-
 - a) Antidote: EDTA –IV 10-15 mg/kg body wt. twice in first day. If tolerated well then repeat for next 4 days.
 - b) Peritoneal dialysis for lead excretion in case of patients

having renal failure or who are sensitive to EDTA.

- c) Penicillamine is in a way better than EDTA because it is less toxic than EDTA. dose- 30mg/kg body wt per day, orally in 4 divided doses for 7 days or 1-3 gm in slow normal saline drip for 2-4 days.

Postmortem findings-

- Externally:- Emaciated body. Early Rigor mortis.
- Internally:- Irritation of G.I.Tract. Stomach wall swollen, mucus membrane congested, often grayish in colour. Inside curdy white lead chloride may or may not be present. The length of intestine is inflamed.

Chronic Lead poisoning: (Plumbism, Saturnism or Saturnine poisoning)

Lead poisoning is nearly always of the chronic type. It can be seen among those persons employed in factories and industries in which lead and its salts are used, mostly due to the inhalation of lead dust and fumes. Thus it occurs in paint sprayers or burners, compositors, plumbers, enamel workers, glass blowers, electric light workers, glaziers, lead ore refiners and card players. It may result from tinned food contaminated with lead, constant use of hair dyes cosmetics containing lead.

Sign symptoms of chronic Lead poisoning—

- a) Facial pallor – Earliest sign. May be due to vasospasm at arterial side.
- b) Anaemia—Not severe. It is due to impairment of Haem synthesis. Also due to increased fragility of the Red blood cells due to loss of intracellular

permeability of the cell membrane for potassium.

- c) Punctate basophilia—The presence of many dark blue coloured pinhead like spots in the cytoplasm of red blood cells.
- d) Burtonian line—A bluish discoloration over the gingival line with deposition of lead sulphide .
- e) Colicky pain—Spasmodic, paroxysmal pain. Relieved by pressure on abdomen. Involving intestines, ureters, uterus, blood vessels, is a more common feature and occurs in about 85% cases.
- f) Constipation-- During the pain there is a desire for defecation.
- g) Lead palsy— Due to degeneration of nerves and atrophy of muscles. There may be numbness, hyperesthesia, fibrillation, tremor and muscle cramps. Wrist drop, foot drop due to paralysis of extensor muscles of wrist and of anterior tibial muscles respectively.
- h) Lead encephalopathy—Due to inactivation of monoamine oxidase due to combination of lead with the SH radical of the enzyme. Personality changes, restlessness, fatiguability and mental dullness.
- i) Optic atrophy— Few patients may develop blindness due to optic atrophy.
- j) Lead osteopathy—In children or young ones, lead is deposited beyond the epiphysis of the growing long bones. The deposition is promoted by calcium and vitamin D.
- k) Effects on Reproductive system— Sterility in male and female. Birth of mentally or physically handicapped child is possible. In males loss of

libido. In females menstrual disorders, abortion.

- l) Reno vascular manifestations—There may be chronic interstitial nephritis. Vascular constriction results in hypertension and arteriolar degeneration.
- m) General symptoms—Weakness, anorexia, metallic taste in mouth, foul breath, headache, vertigo, irritability, drowsiness and arthralgia.

Laboratory investigation and findings:

In living patients, blood, urine, stool examination for estimation of Lead in them. In children, in addition, X-ray examination of the epiphysis ends of the long bones may be useful.

Blood—Normal range of level of Lead:- 0-50 ug%. the blood range with presence of clinical features vary usually between 0.1 mg% - 0.6 mg%. More than 200 punctate basophilia cells per cmm is diagnostic.

Urine— Porphyrinuria- the amount of excretion more than 500mg per day.

Presence of 0.25 mg of lead per litre of urine.

Glycosuria and Aminocarduria seen in children.

X ray – Evidence of of transverse opaque bands at the end of long bones is present in children. In tetra ethyl lead, liver may appear abnormally opaque on X-ray.

Stool—A total daily excretion of more than 0.5 mg is suggestions of lead toxicity.

Diagnosis of Lead poisoning-- A detailed and careful investigation regarding the type of work done, a thorough chemical examination and the quantitative estimation of the lead content in the urine and the blood confirm the diagnosis. Clinically, this may be

suspected from colic, burtonian line on gums, palsy.

Treatment of Chronic Lead poisoning:

Prophylaxis:- Precautionary steps to prevent toxicity in the workers of the lead industries are must. Inhalation of dusts may prevented by moistening devices. Proper ventilation should be there and masks may be used to avoid inhalation of lead vapors. Regular medical check-up of the workers should be there. Appropriate steps should be taken when they develop minor signs or changes in blood and urine.

Avoid unwashed fruits (fruit preservation- lead arsenate is used). Avoid tinned food, Hair dyes, and cosmetics containing lead. Children may be in the habit of chewing toys painted with lead compounds. This should not be allowed.

Curative— If sign symptoms of chronic lead poisoning have developed then avoid the exposure first.

EDTA 30-40 mg per kg body weight, given in one hourly infusion, twice a day, for 5 days. Repeat after a gap of 3-5 days. Penicillamine 500mg 4 times a day may be given in place of EDTA. Sodium and potassium iodide 1-2 gm, thrice a day helps removal of lead from bones. Sodium or potassium citrate helps excretion of the lead in circulation. For colic 0.5 -1 mg of atropine sulphate and or hot compression on the abdomen is helpful. For constipation Magnesium sulphate purgative is used. Lead encephalopathy in children may need surgical decompression of the skull.

Calcium gluconate or milk intake for few days helps to shift lead from blood to the bones.

Death occurs due to encephalopathy, liver or kidney damage due to circulatory failure.

Post mortem findings:-

Externally- Emaciated body. Burtonian line.

Internally:- Degenerative changes in different tissues or organs like liver. Interstitial nephritis. Arteriosclerotic changes in vessels. In the bone marrow, there is decrease in fat cells and erythroblasts and leukoblasts. Signs of degeneration of anterior horn cells and meningo-encephalitis seen. Ulcerative and hemorrhagic changes in the stomach and intestine.

Medico-legal points of lead poisoning:-

- 1) Acute poisoning is rare. Victimnes are usually children, lead industry workers.
- 2) Rarely used for homicidal poisoning.
- 3) Lead poisoning is usually accidental. It may occur in children from eating paint, chewing toys.
- 4) Sub acute or chronic lead poisoning may be due to contamination of food or drink.
- 5) Chronic lead poisoning more common from various sources.
- 6) Suicidal, homicidal uses very rare.
- 7) Preparations of lead are used for criminal abortion can cause death.
- 8) Can be used as cattle poison.

Discussion:

Lead is used by human beings since last many years. We are using lead from our homes to working place, everywhere and all time. Among all metal poisons lead poisoning is more prominent. The chief compounds of lead which produce poisonous effects are

acetate, carbonate, chromate and oxides of lead. Children, industry workers exposing to lead and are at higher risks. Though detail study of Lead toxicity is given in literature, people are less aware. It is needed to write about it in newspapers, magazines, televisions, radios so as a common man can understand and aware about lead toxicity. Doctors must do the tests for lead detection in their patients who are in close contact with lead or showing sign symptoms of it. Special attention should be given to children in this regard. Lead affects all the systems of our body especially central nervous system, gastric system, respiratory, renal and reproductive system. Cases of chronic lead poisoning may be referred to a medical practitioner under the modified Workmen's Compensation Act 1923, for the workmen who contract the disease in the course of and by reason of their employment are entitled to compensation from their employer during such time as they are incapacitate from earning or if death occurs due to disease, the dependants of the deceased are entitled to compensation.

Conclusion:

- 1) Lead is a metal poison. Exposure to lead compounds by inhalation, swallowing, skin contact affects deleteriously on human body. It affects almost every system of body like respiratory, central

nervous system, gastrointestinal system etc.

- 2) Lead is a cumulative poison. It gets deposited slowly on bones, hair and tissues of organs. The compounds of lead, their uses, sources, exposure, diagnosis, sign symptoms, treatment, Prevention and medico-legal points are described in this review, which will updates the readers about lead toxicity.

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