



Review Article

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AYURVEDIC ASPECT OF LEAD AND ITS CHRONIC TOXICITY

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ABSTRACT

Chronic Lead toxicity is found in form of occupational or environmental exposure with leading encounter during manufacturing, transportation and utilisation of Lead and its compounds. Though information about the Lead toxicity is not found in Brihatrayi like Charak, Shushrut, but it is found in text book of Ras Tarangini, Ayurved Prakash, Vrahat Ras Raj Sundar etc. in detail. As the Lead toxicant accumulate on cellular level after chronic and persistent exposure like Cumulative Poison (Dushee Visha) and its toxic effect after existence of some aggregative factors. It vitiates all the dosha, but Vata and Pita is vitiates more predominantly. It affects all the system (strotas), but Central nervous system (Majava strotas), Haematology (Ras-Raktavaha Strotas) and Gastro intestinal tract (Annavaaha strotas and Purishvaha Strotas) are more affected. There is no such treatment of chronic lead toxicity found in Ayurvedic Original Text, but Enema (Basti) therapy after Bio-purification and then symptomatic management may give complete relief.

Keywords: Lead, Lead Toxicity, Naga Bhasma.**INTRODUCTION**

Lead Poisoning is not a new problem and found in both Ayurveda as well as Modern Text. Though in developed countries Lead Poisoning is not prevalent however in developing country like India it is extremely common to such an extent that it remain the most common type of occupational poisoning. The most common occupational and environmental exposures to lead are encountered during manufacturing, transportation and utilization of Lead and its compounds. Ayurveda is an ancient science and it mentions various drugs (Kalp) and toxicity of Lead in details. Lead, it mimics with one subtype of Cumulative (Dushee Visha), as it accumulate on cellular level and exist for several years. In Ayurveda biopurification by means of inducing emesis, purgation

and bloodletting is useful to remove the accumulated toxicant like a Lead.

Aim

- To discuss, evaluate and elaboration on Ayurvedic aspect of Lead and its chronic toxicity in Human.
- To establish the complete protocol of Ayurvedic management for chronic toxicity of Lead.

MATERIALS USED

This article is based on personal experiences and textual review. Material related to Lead and its chronic toxicity in Human was collected. All the Brihatrayi, Laghutrayi and available commentaries of those has been reviewed. Modern Texts and various websites to collect information on the relevant topics were referred.

Conceptual Study

Table 1: Ayurvedic Properties of Lead

S. No.	Properties	Ayurveda Prakash	Brihat Ras Raj Sundar	Ras Tarangini	Ras Ratna Samuchaya
1	Sweet (Madhur)	-	-	✓	✓
2	Bitter (Tikta)	-	-	✓	✓
3	Heavy (Guru)	-	✓	✓	✓
4	Oily (Snigdha)	-	-	✓	✓
5	Hot (Ushna)	-	-	✓	✓
6	Soft (Mridu)	-	-	✓	✓
7	Vat nashak	✓	✓	✓	✓
8	Pit nashak	✓	-	-	-
9	Kapha nashak	✓	✓	✓	✓

Most of the Text of Ayurveda mentioned that Lead have Vat-Kaph Nashak properties except Ayurveda Prakash which mentioned it as a Tridosh nashak, Madhur Ras, Guru and Snigdha Guna causes pacification of Vata and Tikta Ras and Ushna Guna causes pacification of Kapha. Hence it is uses in Vat-Kaphaj Vyadhi.

Sources**Industrial**

Chronic Lead poisoning may occur in the industrial environment due to inhalation of lead dust or lead vapour arising from burning of paints, battery, smouldering, glass blowing and polishing, enamel factories dye, cosmetic etc¹. It is encountered in various industries e.g. Through

ingestion in typesetting, plumbing, glazing pottery, manufacture of white lead, diamond cutting, file making, turning, car welding and polishing, in person who handle petrol and gasoline, electric light workers, lace workers, lead ore refiners, card players, radiator repair, gold ore extraction and construction (demolition)²⁻⁵.

Drinking water

It may also occur due to low dose consumption from drinking water supplied through lead pipes⁶

Containers

Chronic lead poisoning occurs in India from the use of Ghee (butter) stored in brass or copper vessels lined inside with tin. Ghee becomes impregnated with lead derived from the tin, which sometimes contains lead as an impurity and forms a poisonous salt, the oleate of lead⁷.

Therapeutic uses

Lead acetate used in therapeutics, certain folk medicines (Alarcon, alcohol, Bali golly, coral etc.) contain large amount of lead^{8,9}.

Cosmetics

Sindoor used by Hindu women and Surma used by Muslim women, where lead is part of Sindoor and Surma¹⁰.

Moonshine whiskey

Lead poisoning from drinking illegally distilled liquor is still a cause of death among adults in the southern United States¹¹.

Gunshot wound

Toxic amount of lead can be absorbed from bullets or bullet fragments that remain in the body after emergency surgery¹¹.

Toxic Compound

Lead acetate (sugar of lead)

It has been used in therapeutics,

Carbonate (white lead)

It is still used in paints,

Lead oxide (litharge)

It is essential for glazing of pottery and enamel wire.

Tetraethyl lead

It is mixed with petrol as antiknock to prevent detonation in internal combustion engines.

Lead tetra oxide

Compound of vermilion (sindoor),

Lead sulphate

It is used as a collyrium (surma)¹².

Route of Exposure

Oral

Drinking water supplied by lead pipe and food stored in lead container causes lead poisoning by oral route. Chronic lead poisoning results from daily intake of 1-2 mg of lead.

Inhalation

Inhalation of lead dust or lead vapour

Dermal

It is exposing to women when she used Sindoor on scalp and Surma used on eyes. Tetraethyl lead absorbed by skin^{13,14}.

Table 2: Chronic Toxicity of lead as per Ayurveda and modern

S. No.	Disease	Ayurved Prakash ¹⁵	Brihat Ras Raj Sundar ¹⁶	Ras Tarangini ¹⁷	Harrison medicine ¹⁸	Forensic Toxicology ¹⁹
1	Renal disorder (Prameha)	✓	✓	✓	✓	✓
2	Wasting (Kshay)	✓	✓	✓		
3	Jaundice (Kamala)	✓				
4	Skin disease (Kustha)	✓	✓	✓		
5	Flatulence (Gulma)	✓	✓	✓		
6	Blood disorder (RaktVikar)		✓			
7	Anaemia (Pandu)	✓	✓		✓	✓
8	Loss of appetite (Agnimandhy)	✓	✓	✓		
9	Anorexia (Aruchi)		✓		✓	
10	Oedema (Shoth)	✓		✓		
11	Fistula ano (Bhagandar)	✓	✓	✓		
12	Fever (Jwar)		✓			
13	Renal stone (Asmari)		✓			
14	Abdominal colic pain (Shool)		✓	✓	✓	✓
15	Joint pain (SandhiSool)			✓	✓	✓
16	Headache (ShirShool)				✓	
17	Irritability				✓	
18	Loss of short term memory				✓	
19	Lead line (Nag rekha)				✓	✓
20	Loss of fair, Pallaness (Sobhahani)			✓	✓	✓
21	Menstrual irregularity (Rajovikar)					✓

Renal disorder, wasting, skin disease, anaemia, loss of appetite, anorexia, fistula in ano, abdominal colic these are the clinical manifestation mainly found in Ayurvedic text and renal disorder, anaemia, abdominal colic, joint pain, paleness these clinical features found in modern textbook, while renal disorder, anaemia, abdominal colic found in both.

Complication (Updrava) of Chronic Toxicity of Lead Lead induced hypertension

Intense and prolonged lead exposure has been shown as a cause of hypertension. Indeed, observations of lead poisoning effects secondary to exposure to high levels showed increased incidence of strokes, kidney disease and hypertension. An increased incidence of hypertension was also described in communities exposed to lead-containing moonshine. More recent studies have shown that there are harmful effects of low level exposure to lead which is commonly found in the general population. Potential effects on adult blood pressure have been described in populations encountering common environmental concentrations²⁰.

CNS and Neurobehavioral Changes

Studies published in the scientific literature indicated very clearly that lead poisoning is associated with significant neurobehavioral changes. If lead affects the central nervous system in the same way as other toxic substances, it is reasonable to expect that a dose response relationship exists and that individuals with low to moderate blood levels will manifest neurobehavioral disorders that are qualitatively similar to, although less severe, than those found in lead-toxicities adults with higher levels²¹.

Lead related Nephrotoxicity

Lead nephropathy, characterized by chronic tubular interstitial nephritis, is a well-known risk of chronic, high-level lead exposure. However, in recent years, lead exposure has declined sharply, particularly in developed countries. We reviewed epidemiologic research in general, occupational, and patient populations to assess whether lead, at current exposure levels, still contributes to nephrotoxicity²².

Mental and physical retardation and deafness

New evidence suggests that lead may be harmful to children even at low levels that were once thought to be safe, and the risk of damage rises as blood levels of lead increase. The symptoms of chronic lead poisoning take time to develop, however. Children can appear healthy despite having high levels of lead in their blood. Over time, though, problems such as the following may arise: learning disabilities, mental retardation, slowed growth and hearing loss²³.

Lead palsy

Lead palsy is rather a late and uncommon phenomenon. Only about 10 % of patient usually suffers from this condition. Lead induced peripheral demyelination is reflected by prolonged nerve conduction time and subsequent paralysis, usually of extensor muscles of the hands and feet (Wrist drop and foot drop). It is said to be

due to interference with phosphor creatinine metabolism at the muscular level²⁴.

Lead encephalopathy

It is more common in the 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. There changes may occur in personality, restlessness, fatigability and mental dullness, in some cases there may be acute conditions like convulsion, delirium and coma²⁵.

Sterility and Impotency

Chronic exposure may cause sterility in both male and female. In male there may be loss of libido²⁶.

Retinal stippling

Retinal stippling is noticed by ophthalmoscope examination showing presence of greyish glistening lead particles, in the early phase of chronic lead poisoning²⁷.

Carcinogenicity

Occupational studies by International Agency for Research on Cancer (IARC) on highly exposed workers evaluated the cancer of the lung, stomach, kidney, brain and nervous system and based on available data concluded that there is limited evidence for the carcinogenicity to human following the exposure to inorganic lead compound. IARC also discussed the mechanistic aspect of lead as a potential carcinogen and concluded that the mutation, cell proliferation and changes in gene expression, all of which may contribute to a carcinogenic response if exposure is sustained²⁸.

Chronic Toxicity of Lead on Vatadi Doshha

Chronic lead toxicity causes vitiation of all the three doshas, out of vata-pita found predominantly vitiated. As lead toxicity impair metabolism (chaya-pachaya) that causes vitiation of vata due to waste of the humours (Dhatukshaya).

Chronic Toxicity of Lead on System (Srotas) as Per Ayurveda

- Annvah strotas- Loss of Appetite, Anorexia, Pain in Abdomen, Vomiting
- Rasvah strotas- Fever, Anorexia, Indigestion, Loss of fair, Oedema, Fatigue, Anemia, Sterility
- Raktvah strotas- Skin disease, Jaundice, Menstrual irregularity.
- Mansavah strotas- Wasting of muscles
- Medovah strotas- Renal disorder
- Asthivah strotas- Osteopathy, Joint pain, lead line
- Majjavah strotas- Headache and irritability, short term memory loss, paralysis.
- Sukravah strotas- Sterility in both male and female
- Mutravah strotas- Dysurea, Renal disorder, renal stone.
- Purishvah strotas- Constipation, Flatulence, Fistula in anus
- Artavvah strotas- Menstrual irregularity, Female sterility

Investigation of Lead Toxicity

When Blood level exceeds more than 0.48 $\mu\text{mol/L}$ (10 $\mu\text{g/dL}$) in Child, then specific set of interventions is recommended, while when level exceeds more than 1.9 $\mu\text{mol/L}$ (40 $\mu\text{g/dL}$) then requires the regular measurement of blood lead in lead-exposed workers. Lead associated anaemia is usually Normocytic and Normochromic may

be accompanied by basophilic stippling. In Lead induced wrist drop and foot drop, prolonged nerve conduction time due to peripheral Demyelination may be found. Density at the metaphysealplate of growing long bones may be increased called lead lines. X-ray fluorescence is being investigated as a method for estimating long term accumulation of lead in bone²⁹.

Table 3: Management of Chronic Lead Toxicity with special reference to Dushee Visha

S. No.	Procedure and Drugs	Sushrit ^{30,31}	Charak ³²	Ashtang Sangrah ³³	Ashtang Hrudaya ³⁴	Yograt nakar ³⁵	Bhavprakash ³⁶	Vang-sen ³⁷
1	Sudation (Swedan)	✓	-	✓	✓	✓	✓	✓
2	Induced Emesis (Vaman)	✓	-	✓	✓	✓	✓	✓
3	Induced Purgation (Virechan)	✓	-	✓	✓	✓	✓	✓
4	Dushee Vishari Agad	✓	-	✓	✓	✓	✓	✓
5	Blood Letting (Sira Karma)	-	✓	-	-	-	-	-

All the Acharya except Charak mentioned the Sudation followed by induced emesis or induced purgation or both able to excrete the cumulative poison (Dushee Visha) from human body by means of purification and then administration of Dushee Vishari Agad after conciliating step (Samsarjan Krama). Acharya Charak has suggested bloodletting and medicine prepared from milky juice of Euphorbia, while Acharya Vagbhat has suggested mild purgative which is already mentioned in Kashyap Samhita in addition.

Schedule for Management of Chronic Toxicity of Lead (Self-Created)**Internal Oleation**

By Haridradi Ghrita which having a contain-*Curcuma longa* (Haridra), *Emblica officinalis* (Amalaki), *Terminalia bellirica* (Vibhitaki), *Azadirachta indica* (Nimba), *Sida cordifolia* (Bala), *Glycyrrhiza glabra* (Mulethi)- may be given for oleation therapy in dose of 50 ml at first day with 150 ml Milk and increased by 50 ml every day till the adequate clinical sign of Oleation will be found³⁸.

Sudation

Just before the procedure of induced purgation, box Sudation should be given all over body below neck till the adequate sweating found.

Induced Purgation

At the day of induced Purgation, milky juice of *Euphorbia nerrifolia* (Snuhi Ksheera) 125 ml dried in Rock Salt (Saindhava) and mixed with Triphala decoction 500 ml, once in early morning³⁹.

Conciliating Step (Samsarjana Krama)

Green Gram (Mung dal) water at afternoon and evening after adequate appetite in 1st day, Green Gram (Mung dal) Khichadi at lunch and dinner after adequate appetite in 2nd day and same as 2nd day in 3rd day

Suitable Diet and Transposition-

Gramdal, *Sesamum indicum* Seed Oil, Brinjal, Snake Guard, *Ameranthus spinosus*, *Phyllanthus embilca*, Rock Salt 15 day.⁴⁰

Unsuitable Diet and Transposition (Apathya)

Incompatible food, eating too soon after meal, anger, laborious work, sexual intercourse, Day sleep.⁴¹

Blood Letting

In case of patient having manifestation of skin disease predominantly and not cure by process of bio purification, 60 ml daily at morning for 7 day along with Rakta Shodhak Drugs⁴².

Terminalia chebula (Haritaki)

Churna 5 mg and pure gold bhasma 20 mg with refined sugar may be benefited in case of cumulative versus chronic toxicity of lead for three days after samsarjan karma of purgation procedure⁴³

Enema (Basti) Therapy

Anuvasan and Asthapan Basti of Nirgundi Quath up 300 ml and Tail (Oil) up 150 ml respectively may be benefited on alternate a day.

DISCUSSION

Industrial exposure is main source for chronic toxicity of lead, while water supplied by lead pipe, food container having lead, drug having lead component and cosmetic are associate sources. Moonshine whisky and gunshot wound are rare source. Oral, inhalation and dermal exposure cause chronic toxicity of lead, although no clinical manifestation belonging to respiratory system are found. Renal disorder, anaemia, abdominal colic, joint pain, paleness, and jaundice these clinical manifestations are found in both Ayurvedic and modern text. Other clinical feature of skin disease, fistula in ano etc. are found in Ayurvedic text only which may be due to ingestion of impure lead. Lead induced hypertension, neurobehavioral changes, nephrotoxicity, mental and physical retardation, deafness, lead palsy and encephalopathy, sterility, impotency and retinal stippling are the major complication due to cumulative versus chronic toxicity of lead. Chronic lead toxicity revealed that all the three Doshas are vitiated but Vata and Pita are predominantly vitiated. Chronic toxicity of Lead on various strotas revealed that all the strotas vitiated except Pranvaha, Udakvaha and Swedvaha. Annavaha, Rasvaha, Raktavaha, Majjavahstrotas predominantly vitiated and asthivaha, Sukravaha, Mutravah, Purishvaha and

Artavvah strotas moderately vitiated while mansvaha and medovaha strotas mildly vitiated. Cumulative versus chronic toxicity of Lead on various system revealed GIT, CNS and reproductive system are predominantly vitiated and CVS, haematology and excretory system are mild to moderately vitiated, while respiratory system have no effect. Although sudation, induced emesis and purgation, bloodletting along with Dushivishari Agad has been mentioned for management of Dushee Visha, but in cumulative versus chronic toxicity induced lead, Pita and Vata vitiation predominant, hence sudation and induced purgation may be benefitted. Haridradi Ghrit may be beneficial for internal oleation as it having antitoxic herb. Constipation is the main feature in cumulative versus chronic lead toxicity, though oleation is not mentioned in treatment of Dushee Visha. During the process the medicated Ghrita bind the molecule of lead which already exists in cell and increase the volume of cytoplasm. When Sudation till the adequate sweating is given just before the biopurification the permeability of the cellular membrane is increased. As Euphorion is best and indicated for Dushee Visha, milky juice dried in rock salt and mixed with Triphala Decoction and it may be useful to excrete the cumulative pesticides by means of Induced Purgation. During the procedure of conciliating step the process of cellular phosphorylation may burn the reserved food along with toxicant due to food hunger of cell and it play important role in curing the patients. Most of the suitable diet likes *Ameranthus spinosus*, *Phyllanthus embilca* etc. have antitoxic in nature and may be helpful to balance the cellular metabolism. Bloodletting which is mentioned in Chark Samihita for Dushee Visha can be used in patient having skin disease due to lead exposure or ingestion of medicine prepared by impure lead. *Terminalia chebula* powder along with gold bhasm may be benefitted. Anuvasan Basti by nirgundi tail and Asthpan Basti by Nirgundi Quath alternatively may benefit in chronic lead toxicity Vata Prakop and constipation both.

CONCLUSION

Chronic toxicity of Lead is significant problem due to occupational and environmental exposure as well as consumption of drinking water by mean of Lead pipe channel in India. There is no such treatment of chronic lead toxicity found in Ayurvedic original text, but Enema (Basti) therapy after bio-purification and then symptomatic management may give complete relief.

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