



A REVIEW ON LEAD TOXICITY AS PER AYURVEDA

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ABSTRACT

Lead poses the greatest threat to human health from environmental exposure. Because of its significant physicochemical characteristics, it has been helpful throughout history. It is a typical, significant, and perhaps hazardous metal that is present in our surroundings. In Ayurveda, lead is also referred to as a poisonous metal. Science and authentic Ayurveda scriptures are used to acquire data on lead poisoning. Ayurveda, on the other hand, processes numerous toxins using a variety of methods that eliminate their harmful properties, making them potent enough to be used as a very effective treatment when provided in a very small dose. Likewise, Lead can also be utilized as a very effective treatment after passing through a series of proper purifications. Ayurveda also claims that the administration of lead after improper cleansing will undoubtedly have negative effects. Additionally, it covers the potentially fatal symptoms and signs caused by the ingestion of lead that has not undergone the proper refinement. The claim that Ayurvedic treatments induce heavy metal poisoning is currently being made as a result of subpar metal processing performed by unstandardized companies prior to use in formulation. As a result, this article's primary emphasis is on the features of lead toxicity explained in the ancient works of Ayurveda.

KEY WORDS: Lead toxicity, Ayurveda formulations, lead pharmaceuticals, lead compounds, naga.

INTRODUCTION

Major heavy metals causing environmental threat constitutes lead, thallium, cadmium, and antimony, which are significantly more in industrial areas. The risks associated with these metals often outweigh their benefits. They can be hazardous to human body by causing various systemic effects. (1) Every year, around 1 million individuals die from lead poisoning, and more children experience long-term health problems. (2) Ayurveda clearly mentions lead as a toxic metal, and explains its toxicity features along with its treatment. It also specifies various detoxifying procedures of metal that retains their benefits without any adverse reactions. This review highlights the toxic consequences of lead mentioned in ayurveda and its relevance in present day study.

MATERIALS AND METHODS

Data is gathered from classical sources, various publications, and websites.

THEORY

Lead is described in Ayurveda using terms like seesa, naga, kuranaga, and sindoor karanam. It also offers a comprehensive explanation of lead, which is further separated into two groups kumara and samala. Where it is recommended to use kumara in rasakarya. It also outlines the qualities of good quality lead, such that it should be drutha dhavam (melts quickly), maha bharam (extremely heavy), have an internal surface that glows

blackly when cut, release foul odours when heated, and have a black exterior. (3) It states that lead should be strictly avoided if purificative treatments (shodhana) and methodical ash formation techniques (marana) are unsuccessful. Lead is regarded as a toxin, and its toxicity features are described. Humans are generally exposed to lead and its compounds through multiple sources. The manifestations of lead toxicity mentioned in Ayurveda and recent scientific findings are compared in this article.

RESULTS

According to recent studies, lead has an impact on almost all of the organs in the body, with the nervous system being the most frequently affected. It was shown that both adults and children who were exposed to high lead levels died as a result of serious brain and kidney impairment. (4) Ayurveda also says that exposure to unprocessed lead kills a person. (5) Below is an explanation of systemic toxicity features brought on by lead.

Hepatic Toxicity

As liver is one of the primary organ involved in the storage, biotransformation, and detoxification of all hazardous chemicals. Soft tissues of the liver retains majority of the absorbed lead is hence, it is the first organ to show histological changes. In a study during a histological analysis hepatocyte hypertrophy and hepatic cord disarray were two changes that were discovered. Furthermore, liver toxicity appears as cell vacuolation as a physiologic response to hazardous substances.



Cellular metabolism was unaffected since these substances were divided into vacuoles. Problems with lipid inclusions and fat metabolism have been proposed as the primary causes of cytoplasmic vacuolation. Following lead exposure, indications of liver injury include lymphocytic infiltration and sinusoidal blood congestion. (6) *Ayurveda* explains certain signs of toxicity such as *vahni mandya* (loss of appetite), *gulma*, *anaha*, (abdominal distension) *kamala* (jaundice), and *kshaya* (emaciation) which makes a clear reference of lead inducing hepatotoxicity. (5)

Renal Toxicity

According to recent studies, Depending on the duration of exposure, the age of the animals, and the target, the data showed that lead significantly affects the liver and kidneys. Moderate to high exposure of lead, produces free radicals, which in-turn causes oxidative damage to vital proteins, lipids, and macromolecules. An experimental study revealed, adult lead-exposed animals showing signs of nephropathy whereas, young lead exposed animals showed impairment of liver's ability to synthesize compounds than their kidneys.(7) *Ayurveda* explains *prameha* (5) as an ailment caused by lead toxicity, which includes various presentations of impairments in kidney, ureter, and bladder. This denotes the potentiality of lead inducing nephrotoxicity.

Nervous System

Recent studies have shown that the brain is the organ that is most sensitive to lead exposure. Adults who have been exposed to lead over an extended period of time do poorly on cognitive tests, which indicates a decline in brain functions. Lead also has an impact on the evolution of neurochemicals including neurotransmitters and the organization of ion channels. In addition to impairing neurotransmission, lead poisoning also causes loss of myelin sheath in neurons and slows neuronal growth and number. Blood concentrations of 100 g/dL were found to be associated with more severe diseases in adults, such as persistent central nervous system dysfunction. (4) Lead encephalopathy, a disorder that can cause sudden psychosis, confusion, and reduced awareness, may develop in extreme situations. Memory loss, slow reflexes, and decreased comprehension are some effects of prolonged lead exposure. People with average blood lead levels of less than 3 mol/l report reduced nerve conduction velocity and impaired cutaneous responsiveness as symptoms of peripheral nerve complaints, which can remain permanent in severe cases. (8) *Ayurveda*, mentions *pakshavadha* (paralysis) and *bahvo nischestatha* (absence or reduction in peripheral nerve conduction) symptoms as ailments caused due to lead.(5) This indicates neurotoxic action of lead explained in both the sciences.

Circulatory System

Recent investigations have found that the most obvious sign of chronic lead toxicity is anemia, due to disruption in hemoglobin production, and increased destruction of RBCs that in turn lead to increased bilirubin level. (8) Middle-aged and elderly people with prolonged lead exposure has been associated with anemia and a rise in blood pressure. (4) *Ayurveda*, clearly explains lead toxicity causes *kamala* (jaundice) that is considered to be the chronicity of ailment *pandu* (anemia). (5) By this *Ayurveda* has clearly indicated that lead toxicity causes destruction of RBCs and impairs production of RBCs.

1.1 Reproductive System

A miscarriage could occur if a pregnant woman is exposed to a high concentrations of lead. Chronic lead exposure has also found to reduce male fertility. (4) *Ayurveda* considers *shukra* to be the important *dhathu* responsible for proper functioning of reproductive system, which is the essence of all *dhatus*. Hence, when lead toxicity affects other tissues, it undoubtedly affects the functioning of reproductive system.

Integumentary System

Recent research has demonstrated that patients with mean BLLs of 11.58 g/dL or higher had symptoms of gingival brown pigmentation in 83.6% of cases, gingivitis in 82.8% of cases, and lead lines in 49.3% of cases. Subjects with noticeably increased BLLs and gingivitis were found to have the lead line. Patients showed significantly less elasticity and skin hydration as measured by corneometer. Which showed an increased risk of skin damage. (9) In *Ayurveda Rasatarangini* text explains first sign as loss of *shareera shobha*, which is loss of body's natural lustre and glow. Which shows that lead toxicity affects integumentary system initially. (10)

Gastro Intestinal System

According to recent studies, lead toxicity reduces intestinal motility, interferes with sodium transporter channels in the intestine, may result in pancreatitis, nausea, abdominal distention, constipation, and decreased appetite. (11) *Ayurveda* mentions various gastrointestinal manifestations like *anaha* (abdominal distention), *gulma*, *vahni mandya* (reduced appetite), *bhagandara* (fistula in ano), *shola* (severe piercing pain), *kshaya*, (emaciation) (10) Which clarifies that lead toxicity affects gastro intestinal system.



Below is a list of symptoms from Ayurveda that have been compared to modern research findings

SYMPTOMS MENTIONED IN AYURVEDA	MODERN CORRELATION	RECENT STUDIES
<i>SHAREERA SHOBHA</i>	Loss of body luster	Lead-intoxicated patients show lower levels of moisture and elasticity even in skin that appeared normal. This results implies that at detectable levels, lead may have damaging effects on the skin.(9)
<i>KAMALA</i>	Hepatotoxicity	Animal toxicology studies on lead's hepatocarcinogenic effects have sparked new investigation into the biochemical and molecular components of lead toxicology. Advances in understanding of the molecular mechanisms underlying leads effects on hepatic drug metabolizing enzymes, cholesterol metabolism, oxidative stress, and hepatic hyperplasia point to a potential role for lead in also harming extrahepatic systems, such as the cardiovascular system. The therapeutic potential of chelation treatment for treating animal models of lead induced hepatotoxicity is also effective.(12)
<i>SANDHIM PRAPEEDAYATHI</i>	Arthralgia	Heavy metal concentrations in serum samples from RA patients and healthy controls differ by a significant amount, indicating that heavy metals may play a role in the development of RA.(13)
<i>PAKSHA VADHA, BAHVO NISCHESTATHA</i>	Paralysis	Lead palsy is the result of peripheral nerve involvement, and it typically affects the hands, wrists, and fingers first ("wrist drop"). Children under the age of six, whose brains and nervous systems are still developing, experience the most serious consequences. (14) The organ most vulnerable to lead poisoning is the brain. Lead has a significant impact on synapse development in the cerebral cortex of a developing child's brain. Lead also obstructs ion channel organization and the synthesis of neurochemicals, such as neurotransmitters. Additionally, lead poisoning reduces the number of neurons, disrupts neurotransmission, and stunts neuronal growth in addition to causing myelin sheath loss in neurons. (4) In adults, it was shown that blood levels of 100 µg/dL were linked to more serious disorders, such as chronic central nervous system dysfunction. (4)
<i>GULMA, ANAHA</i>	Abdominal distention	Lead poisoning is a cause of unexplained Gastric dilatation.(15)
<i>PRAMEHA</i>	Disorders of the urinary system	Lead levels should be examined in people who seem to have gout, high blood pressure, or kidney disease. People who work in occupations where they are exposed to extremely high levels of lead are most likely to develop kidney disease associated to lead. The impact on kidney function at lower lead exposure levels (such as from drinking water) requires years of exposure (5 to 30 years) and should be minimal. (16)
<i>SHWAYATHU</i>	Swelling	Lead encephalopathy develops when whole blood lead levels are elevated and exceed 80–100 micrograms/dL. At such levels, lead penetrates the blood-brain barrier, causing the cerebrovascular endothelium to deteriorate and promote capillary leak and oedema.(17) The endoplasmic reticulum and mitochondria in particular were causing intracellular organs to swell, which led to the hypertrophy. (6)
<i>VAHNI MANDHYA</i>	Reduction in digestive fire	Decrease in appetite is noticed during lead intoxication (18)



KSHAYA	Emaciation	Loss of weight (18)
BAGANDHARA	Fistula	This investigation revealed a strong link between constipation and lead toxicity. Which would further progress to fistulas in chronicity. (11)
AMSA SHOTHA	Swelling in the region of the shoulders	
SHOLA	Piercing kind of pain	In 85% of instances, colic of the intestines, uterus, ureters, and blood arteries occur. Colic often happens at night, and the discomfort can be very intense. Individual attacks are short but might happen repeatedly over the course of several days or weeks. Vomiting and diarrhea might happen, but constipation is more common.(19) Abdominal pain is observed (18) Through a number of methodologies, lead can induce stomach pain. Additionally, there is proof that lead plays a part in acute pancreatitis which in-turn may lead to severe pain.(11)
MARANA	Death	Lead damages the brain and central nervous system at high exposure levels, resulting in unconsciousness, convulsions, and even death. (20)

Table 1

DISCUSSION

As lead is considered as harmful metal in Ayurveda, its usage is restricted unless it has undergone a variety of stringent procedures. However, lead also has a lot of therapeutic benefits in addition to its drawbacks. Hence, before employing lead compounds as a component of the medication, it is always advisable to subject it to procedures such as Samanya Shodhana, Vishesh Shodhana, and Bhasmikanana. These methods involve certain herbal-mineral ingredients that neutralizes the harmful effects. The use of medicinal herbs and natural products had significantly minimized experimentally induced heavy metal toxicity in lab animals. Traditional or plant-based medicine have proved to have better results in heavy metal toxicity (20).The metal becomes non-toxic and gets suitable for therapeutic utility. The quality of the finally obtained bhasma, is analysed through Varitara, Rekhapurna, Niruttha, Nischandratva, apunarbhava tests before using it in any formulation. These tests indicate the loss of its metallic and toxic properties. (21) Some pharmacies has missed to follow the procedure in authentic which has resulted into heavy metal toxicity in certain groups of people who took Ayurveda medications. Hence, Ayurveda Pharmacopoeia of India has standardized these practices, which ensures the eradication of negative effects and gives desired therapeutic outcomes.

CONCLUSION

In addition to its numerous medical advantages, lead is a hazardous metal. Before its use in the formulation adopting ayurvedic principles to eliminate their hazardous effects benefits the general population by providing them desired therapeutic effects. However, improper usage of these formulations can act as a toxin and may further cause heavy metal toxicity. As a result, the standards of manufacturing procedures should always be ensured before prescribing pharmaceuticals that include lead compounds.

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