Research Journal of Chemical Sciences ISSN 2231-606X
Vol. **3(8),** 86-88, August **(2013)** *Res. J. Chem. Sci.*

Mini Review Paper

Lead Poisoning - A Review

Tiwari Seema[1], Tripathi I.P.[2] and Tiwari H.L.[3]
[1]AISECT University, Bhopal, MP, INDIA
[2]MGCG University, Chitrakoot, Satna, MP, INDIA
[3]MANIT, Bhopal, MP, INDIA

Available online at: www.isca.in
Received 6th July 2013, revised 6th August 2013, accepted 16th August 2013

Abstract

The lead has been explored and used since last 6000 years and the history of lead poisoning is nearly 2500 years. Symptomatic lead poisoning is the result of very high levels of lead in the tissues. It is possible that the content of lead in the body that is insufficient to cause obvious symptoms can nevertheless give rise to slowly evolving and long lasting adverse effects. It is clear that a continued rise in the pollution of the human environment with lead could eventually produce levels of exposure with adverse effects on human health. Traces of lead are almost ubiquitous in nature and minute amounts are found in normal diets. This article reviews the work done in the field of lead poisoning pertaining to sources of lead, symptoms of toxicity and effects on heme biosynthesis.

Keywords: Lead pollution, blood level, lead poisoning symptoms.

Introduction

Environmental pollution is a global concern affecting the health of human populations adversely. The importance of environmental factors to the public health and their well-being is increasingly apparent[1]. Lead is stable, silver-gray, heavy metal and is found in all phases of the inert environment as well as in most biological systems. Lead is mostly found in the environment as various lead salts in mineral ores. Lead in the environment occurs naturally and as a by-product of human activity, and its concentration and presence in environmental media are highly variable. Normally, lead accumulates near the source points, owing to its physical and chemical properties that minimize the potential for volatization and airborne transport and enhance the tendency for rapid local deposition[2,3]. Lead poisoning is an international problem. Although the individuals of all age groups are affected by the lead poisoning, it is more common in children. Depending on the exposure levels, lead is said to have both mild and adverse effects on the nervous system, growth and development, cognitive development, behavior, hearing, sight, movement and muscular activities, digestive system, excretory system, blood and circulation. Severe lead poisoning, can also lead to death. This paper reviews about the sources and adverse effects of lead to the human health.

Backgrounds on Lead Poisoning

Lead poisoning is a medical condition in humans caused by increased levels of the lead in the body tissues. Lead interferes with the different body processes and is toxic to organs and tissues like the heart, bones, intestine, and reproductive and nervous systems. Initially, lead poisoning can be hard to detect and the people, who otherwise seem to be healthy, can actually have high blood-lead levels. The signs and symptoms usually don't appear until dangerous amounts have accumulated.

Although children are most vulnerable, adults on the other hand are also not less susceptible to lead poisoning. Children and adults, however, differ somewhat in terms of relative importance of different lead exposure sources and pathways, lead metabolism and expression of toxicities. Normally, young children have a tendency of exploring their environment via hand-to-mouth activity that makes them more prone to lead intake than adults[4]. The gastrointestinal absorption of lead in infants and young children is more[5] and is further increased in the presence of nutritional deficiencies that are again more common in children than in adults. The developing nervous system is thought to be far more vulnerable to the toxic effects of lead than the mature brain[6]. Lead poisoning is most significant environmental health threats for children[7].

The lead is a highly poisonous metal. Due to lead toxicity exhibits a variety of symptoms. Lead can be ingested by various sources. A lead –line sometimes appears at the gingival-tooth border after prolonged high-level exposure[8]. The concentration of lead, the total amount of lead consumed and duration of lead exposure influence the severity of health effects. Lead possesses properties that make it attractive for use in numerous industrial processes making it a common pollutant in environments around the world. Even in small quantities, lead displays toxic effects on nearly every major organ system in the body. Acute lead poisoning, resulting in nausea, seizures, coma, and possibly death is extremely rare, and is usually the result of occupational exposures or accidents. Chronic lead poisoning, on the other hand, has no immediately visible or noticeable symptoms. The way to determine the lead poisoning in a child is by lab analysis, using a blood sample[9].

Lead poisoning can cause a variety of symptoms and signs which vary depending on the individual and the duration of lead exposure[10,11]. Symptoms are nonspecific and may be subtle, and someone with elevated lead levels may have no symptoms[12]. The main symptoms in adults are headache, abdominal pain, memory loss, kidney-failure, reproductive problems such as reduced sperm count /abnormal sperm in men and miscarriage or premature birth in pregnant women, weakness and pain or tingling in the extremities[13]. The symptoms of lead poisoning in adults generally become obvious when blood lead level exceeds 40 μg/dL[10]. Symptoms of lead poisoning in children appear when lead level in blood becomes around 60 μg/dL[14]. There is a lot of variation in the signs and symptoms of lead poisoning in children which include irritability, loss of appetite, weight loss, sluggishness and fatigue, abdominal pain, vomiting, constipation and learning difficulties. However, the lead-levels at which symptoms appear vary widely depending on characteristics of each individual[15]. At the blood-lead levels between 25 and 60 μg/dL, neuropsychiatric effects such as delayed reaction times, irritability and difficulty in concentrating as well as slowed motor nerve conduction and headache can occur[16]. In adults, when blood-lead level becomes more than 50 μg/dL anemia may appear[17]. Abdominal colic, involving paroxysms of pain, may appear at blood-lead levels greater than 80 μg/dL[11]. Signs that occur in adults at blood lead levels exceeding 100 μg/dL include wrist drop and foot drop and signs of encephalopathy such as those that accompany increased pressure within the skull, delirium, coma, seizures, and headache[18]. In children, signs of encephalopathy such as bizarre behavior, dis-coordination and apathy occur at lead levels exceeding 70 μg/dL[18] . Manifestations of symptoms of lead toxicity are inevitable in both adults and children at blood lead levels exceeding 100 μg/dL[11].

Sources of Lead

There are many sources of lead in our environment. The most lead concentration that is found in the environment is a result of human activities[19]. Lead pipes, often found in older homes, can release lead into drinking water as they corrode. Lead-based solder, a metallic alloy used to connect copper pipes or brass and chrome-plated faucets, was also used in homes until the mid-1980s. Over time, lead solders release lead particles into tap water, contaminating drinking water. According to the New York State Department of Health, in 1986, Congress restricted lead solder to contain no more than 0.2 percent lead, and lead in pipes, faucets and other plumbing materials to no more than 8 percent. Before 1973, gasoline contained an additive known as tetraethyl lead. Fumes from vehicle exhausts powered by gas with tetraethyl lead were found to be highly toxic and resulted in widespread lead exposure. Lead particles from these fumes settle in the soil and remain in the environment for years. In 1973 the U.S. government phased out gasoline containing lead until it was eventually banned for sale in 1996. Lead-based paints, banned for use in 1978 were the greatest source of lead pollution in the United States. An estimated 24 million homes in the country contain lead paint and high levels of household dust contaminated with lead, notes the Centers for Disease Prevention and Control. Lead paint, previously used to improve the longevity of paint and for its effectiveness in hiding undesirable surfaces, is particularly harmful for children who may eat paint chips peeling from walls or chew on painted toys containing lead. Adults are also exposed to lead from paint when a painted surface chips or cracks. Additionally, improper home renovations can dislodge lead particles and release them into the air in and around the home. Several industries such as the petroleum, mining, smelting, lead-acid battery manufacturing, waste incinerating and mining industries release lead into the air and soil. Workers in these industries can bring lead particles into their homes on their clothes, shoes or skin. Wind-blown dust or soil containing contaminated lead is tracked into homes on shoes, creating an additional source of exposure.

Ceramics, glass, pottery and china containing lead are also the sources of health hazard. Lead from these products or containers reaches into food or drink. Similarly, imported food cans still used in some countries may contain lead solder. The solder, used along the seams of tin cans, can leak into food over a period of time. In the medicinal and cosmetics industries, some products also contain lead. Folk medicines, Azarcon and Greta, both used in India and South Asia to treat upset stomach, are linked to lead exposure. Eye cosmetics such as Kohl and Surma, commonly used as eyeliners, have also been found to contain high levels of lead.

The most common source of lead is lead paint. Lead carbonate was added in the paint to speed drying, improve durability and to protect the surface from corrosion. Lead has been found in candy and candy wrappers imported primarily from Mexico and Asia. Some art supplies, such as artists, paint etc. still possess lead. Some hobbies require the use of lead, such as stained glass, firing guns, making ammunition, and making fishing lures and sinkers. Imported glazed pottery and leaded crystal may also be sources of lead. Drinking water may have lead in it, if permitted levels in municipal sources are not carefully regulated. The largest source of lead in drinking water is through leaching from lead–containing pipes, faucets and solder, which can be found in plumbing of older build. Vinyl mini-blinds imported from china, Indonesia, Taiwan and Mexico before 1997 contained lead, which was used to make them less brittle.

Lead Effects on Heme Biosynthesis

Although lead is devoid of any nutritive value and is not incorporated in the diet of individuals, its intake in the body through various routes is a common feature especially in the areas where lead is used in one or the other form in various products. The increased level of lead intake is responsible for various side-effects in people. Such adverse effects of lead on metabolism have been studied in considerable detail. These effects are related to the concentration of lead in the soft tissues.

One of the most mechanisms of lead toxicity is its effects on various enzymes in the heme biosynthetic pathway. Lead interferes with heme biosynthesis by altering the activity of three enzymes: delta-aminolevulinic acid dehydrase (ALA-D) and Ferrochelatase. Lead stimulates the mitochondrial enzyme ALA-S, which catalyzes the condensation of glycine and succinyl –coenzyme A to form delta-aminolevulinic acid (ALA). Thus, a considerable interference of lead with heme synthesis results in a reduction of the hemoglobin concentration in blood which, coupled with increased erythrocyte destruction, results in a hypochromic, normocytic anemia with associated reticulocytosis. The impact of impairment of heme synthesis by lead is not only limited to the hematopoietic system but also disrupts of a wide variety of important physiological processes.

At the cellular level, the best known adverse effects of lead are its inhibition of the activity of enzymes that are dependent on the presence of free sulfhydryl (SH) groups for their activity. Lead interacts with sulfhydryl groups in such a way that they are not available to certain enzymes that require them. In the living organism, under most conditions, this inhibition is apparently partial. Inhibitory effects of lead on other aspects of cellular metabolism have been demonstrated in laboratory. The clearest manifestation of the inhibitory effect of lead on the activity of sulfhydryl dependent enzymes is the disturbance it causes in the biosynthesis of heme. Heme is the iron-containing constituents that combine with protein to form hemoglobin, the oxygen carrying pigment of the red blood cell. Heme is also an essential constituent of the other respiratory pigments, the cytochromes, which play key roles in energy metabolism[20].

Conclusion

This paper describes about the lead sources and its ill effects for human being. Various attempts have been made to study the lead contents in the environment and to estimate the blood lead levels among people from different walks of life. However, there is still a need to investigate the blood lead levels in people which are presumed to be prone to lead toxicity as a result of occupational hazard. This would enable us in taking preventive measures against lead poisoning as lead poses health risk to everyone[21].

References

1. Rosenstock L., The environment as a Cornerstone of public Health, *Environmental Health Perspectives,* **111(7**), A376-A377 **(2003)**
2. WHO, Lead, *World Health Organization. Geneva*, **(1977)**
3. WHO, Lead –Environmental Aspects, World Health Organization Geneva **(1989)**
4. Lamphear B.P., Hornung R., HOM Howard C.R., Eberly S. and Knauf K., Environmental Lead Exposure During Early Childhood, *J Pediatr.,* **140(4),** 490 **(2002)**
5. Ziegler E.E., Edwards B.B., Jensen R.L., Mahaffey K.R. and Fomon S.J., Absorption and Retention of Lead by Infants, *Pediatr Res.Jan.,* **12(1),** 29-34 **(1978)**
6. Lindsky T.I. and Schneider J.S., Lead Neurotoxicity in Children, *Basic Mechanisms and Clinical Correlates, Brain,* **126**, 5-19 **(2003)**
7. Travis R.J., Solon O., Quimbo S.A., Tan C.M.C., Butrick E. and Peabody J.W., *Elevated Blood –Lead Levels among Children Living in the Rural Philippines, Bulletin of the World Health Organization*, **85(9)**, 674-680 **(2007)**
8. Balakrishnan, Kalpana Study of Lead Exposure and Outcomes Amongst Children in Chennai, India, *Ph.D. Thesis***, (2007)**
9. Patric Michael and Mac Roy A.B. Brown university In search of safe housing, Blood Lead Levels of Past Occupants as an Indicator of Present Lead Safety, **(2000**)
10. Karri S.K., Saper R.B. and Kales S.N., Lead Encephalopathy Due to Traditional Medicines *Current drug safety* **3 (1),** 54–59 **(2008)**
11. Kosnett M.J., Lead, In Olson, K.R. *Poisoning and Drug Overdose* (5th ed.), McGraw-Hill Professional, **(2006)**
12. Mycyk M., Hryhorczuk D. and Amitai Y., Lead, In Erickson, TB; Ahrens, WR; Aks, S; Ling, L. *Pediatric Toxicology: Diagnosis and Management of the Poisoned Child*. McGraw-Hill Professional, **(2005)**
13. Pearce J.M., Burton's line in lead poisoning, *European neurology,* **57(2),** 118–129 **(2007)**
14. Needleman H., Lead poisoning, *Annual review of medicine,* **55**, 209–22 **(2004)**
15. Bellinger D.C., Lead, J *Pediatrics,* **113(4),** 1016–1022 **(2004)**
16. Merrill J.C., Morton J.J.P. and Soileau S.D., Metals, In Hayes, A.W. *Principles and Methods of Toxicology* (5th ed.), CRC Press, **(2007)**
17. Kosnett M.J. Lead, In Brent J., *Critical Care Toxicology: Diagnosis and Management of the Critically Poisoned Patient*, Gulf Professional Publishing, **(2005)**
18. Henretig F.M., Lead, In Goldfrank, LR. *Goldfrank's Toxicologic Emergencies* (8th ed.), McGraw-Hill Professional, **(2006)**
19. Seema Tiwari and I.P. Tripathi, Lead Pollution - *An Overview*, *Int. Res. J. Environment Sci.,* **1(5),** 84-86 **(2012)**
20. Julian J. and Chisolm Jr. Lead Poisoning, *Scientific American Journal*, **224(2),** 15-23 **(1971)**
21. Kapoor Neeti and Tiwari Prakash, Effects of Heavy Metals Poisoning during Pregnancy, *Int. Res. J. Environment Sci.,* 2**(1),** 88-92 **(2013)**