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Blood Lead Level -A Review

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Abstract :*Lead is a toxic metal whose widespread use has created major environmental contamination and health problems in many parts of the world. Human exposure to lead is estimated to account for 143000 deaths every year and 0.6% of the global burden of disease. Lead is a cumulative toxicant that affects multiple body systems, including the neurological, hematological, gastrointestinal, cardiovascular and renal systems. The finding of lead pollution can be difficult when there is no clear history of exposure, because lead affected individuals can be asymptomatic, and signs and symptoms, when they are present, are relatively nonspecific. Laboratory investigations are the only reliable way to diagnose lead – exposed individuals and therefore play an essential role in the identification and management of lead pollution and in the assessment of occupational and environmental lead exposure. Today, laboratories primarily assess lead exposure with whole blood lead measurements. Although a number of other human tissues and fluids, such as hair, teeth, bone and urine, also reflect lead exposure, the concentration of lead in whole blood has gained wide acceptance as the most useful tool for screening and diagnostic testing. Depending on the exposure levels, lead is said to have both mild and adverse effects on the nervous system, peripheral nervous system, growth and development, cognitive development, behavior, hearing, sight, movement and muscular activities, digestive system, excretory system, blood and circulation. In severe lead level, it can also lead to death. In this article blood lead level and health effects has been discussed.*

Key Words: *Blood, Human health, Knowledge, Lead, Nervous system.*

I. Introduction

Lead is a dense, blue-grey, heavy, soft, malleable, non-biodegradable, metallic element that occurs naturally in the earth's crust and is commonly used in modern industries. Some of the significant lead minerals are galena (PbS), cerussite ($PbCO_3$) and anglesite ($PbSO_4$). In the periodic table lead is in IVB group and has a melting point of 327^o C. Metallic lead is tasteless and odourless, but some of the oxides and salts of lead taste sweet, which poses a major problem, especially for children. Lead is insoluble in water, but some of the salts do dissolve, hence lead salts can be carried long distances in water supplies. Lead fumes will be easily formed when lead is heated. It may be noted that most of the Pb intake by a typical city dweller is from diet (about 200 to 300 µg per day), air and water adding a further 10- 15 µg per day each. Of this total intake, 200 µg of Pb is exerted while 25 µg is stored in the bones each day.

The major biochemical effect of lead is its interference with heme synthesis, which leads to hematological damage. Lead inhibits several of the key enzymes involved in the overall process of heme synthesis whereby the metabolic intermediates accumulate. One such intermediate is delta-amino levulinic acid. Lead inhibits the ALA- dehydrase enzyme so that it cannot proceed further to form prophobilinogen. The overall effect is the disruption of the synthesis on hemoglobin as well as other respiratory pigments, such as cytochromes; which require heme. Finally, Pb does not permit utilization of O_2 and glucose for life-sustaining energy production. This interference can be detected at a head level in the blood of about 0.3ppm. The detection of (I) provides a sensitive test for lead in the body. At the higher levels of lead in the blood (more than 0.8 ppm) there will be symptoms of anemia due the deficiency of hemoglobin. Elevated Pb levels (more than 0.5-0.8ppm) in the blood cause kidney dysfunction and finally brain damage.

Ii. Blood lead analysis

Lead is a significant environment environmental contaminant because of its known toxicity to human and other living organisms [1&2]. Lot of work has been carried out by researchers/scientist related with lead. During the literature review, it was found that many researchers /academicians have carried out the work to analyze the lead contents in the blood. Some of them are reported here.

Willoughby and Wilkins [3] suggested that the lead content of the blood under normal and pathological conditions is of particular interest in connection with studies of the absorption and excretion of lead. The result of lead analysis on blood specimens from 189 individuals who gave no history of previous undue lead exposure , and who exhibited no positive clinical symptoms of lead poisoning , were found to range from 0.00 to 0.09 mg of lead per 100 gm. of blood with a most probable value of 0.025 ± 0.002 mg. of lead. Although the most probable blood lead concentration in their cases is considerably less than 0.09mg of lead per 100gm. of blood, it is concluded in agreement with the general consensus that values of this magnitude, as well as 0.10 mg, may occasionally occur without indisputable clinical evidences of plumbism.

Chisolm [4] found that the Young children of urban slums lead poisoning are a major source of brain damage, mental deficiency and serious behavior problems. It is difficult to difficult to diagnose, it is often unrecognized and until recently it was largely ignored by physicians and public health officials. Now public attention is finally being focused on

childhood lead poisoning, although the difficult task of eradicating it has just begun. Symptomatic lead poisoning is the result of very high levels of lead in the tissues. Among the natural substances that man concentrates in his immediate environment, lead is one of the most ubiquitous. A principal cause for concern is the effect on children who live in decaying buildings.

Clausen and Rastogi [5] investigated lead contents among autoworkers in Ireland of Denmark. It was reported that autoworkers have increased blood lead level. About 59% workers have 80µg/dL blood lead level. It was also reported that raised lead values were maximum among diesel engine workers who are exposed to high pressure resistance lubricants containing lead naphthenate.

Kumar et al. [6] studied about the BLL in for Rohtak city situated near Delhi metropolitan city and with a high vehicular density. It was reported that highest levels of blood lead (mean value 21·26 µg/dl). This group of people had a daily exposure of 8–10 h in their business establishments, situated at a distance of less than 5 to about 10 ft (< 1·5m - 3·0 m) from the road with an average traffic density of 8000 vehicles per day. Urban residents were found to have higher blood lead levels (mean value 9·85µg/dl) than the rural ones (mean value 3·34µg/dl). The values were found to increase correspondingly with the increase in age and smoking habits within the particular categories of volunteers.

Liou et al. [7] undertook the experimental work in which adults were selected by multistage sampling methods to investigate environmental lead exposure in Taiwan. The blood specimens were distributed to six laboratories for blood lead levels (BLL) measurement. The mean BLL of the 5913 Taiwanese adults was 8.28 ± 5.39 µg/dl, with a maximum level of 57.6 µg/dl. The median was 7.0 µg/dl and 90th percentile was 15.0µg/dl. BLLs were associated with gender, ethnic group, education level, smoking, alcohol consumption, herbal drug consumption, milk consumption, sources of drinking water, level of urbanization, and occupational lead exposure. These results showed that BLLs in Taiwanese adults were stable during the 2-year study. Most of the influencing factors were consistent with other studies, while local risk factors, such as Chinese herbal drug consumption are important ways of preventing the general population from overexposure to lead.

Al - Saleh et al. [8] conducted the experiments for school girls to determine the lead contents in blood. In this report blood level was found to be more than 10µg/dL. This may be due to the heavy vehicular emission in the school area.

Schirnding et al. [9] studied the distribution of blood lead levels in school children South Africa. It was found that the blood lead level in children significantly high (more than 25µg/dL). It was suggested that the every efforts should be made in South Africa to lower the baseline of children's blood levels. Blood lead levels in these children remained significantly high over the period studied. Intensified, vigilant control of all sources of lead in the urban environment is vitally necessary in South Africa.

Agha et al. [10] have carried out the investigations of lead on blood for traffic police. It was found that blood lead concentration was higher side in those who are regularly exposed to vehicle exhaust in high traffic zone. It is also reported that degree of lead pollution from vehicle exhaust differs from place to place.

Jain et al. [11] carried out the study to know the relationship between blood lead levels and childhood anemia in India. In the study, it was reported that, even small amount (between 10 - 19.6µg/dl) of lead levels in children were significantly associated with elevated risk of severe anemia.

Nichani et al. 12] analyzed BLL children under 12 years of age in two separate sampling campaigns (non-monsoon season & monsoon season). A seasonal trend of BLLs was suggested, with BLL in monsoon season (Geometric Mean = 9.1 µg/dl, SD = 5.7 µg/dl) higher than that in the non-monsoon season (Geometric Mean = 7.3 µg/dl , SD = 4.0 µg/dl). The overall level of airborne dust (PM10) in monsoon season (56.2 µg/m3) was lower than in the non-monsoon season (273.0 µg/m3), presumably due to precipitation. The comparatively higher BLLs in the monsoon season, in the presence of lower air lead levels, suggest ingestion of water or food, with greater lead contamination in the monsoon season, as a possible pathway contributing to elevated BLLs in these children in the monsoon season.

Norman et al. [13] reported that about 4 million peoples in South Africa had blood concentration more than 10µg/dL. It is also reported that blood lead concentration in rural populations are lower than those in urban populations. It is also observed that burden of disease attributed to lead exposure was dominated by mental disability of young children. Even with the phasing out of leaded petrol, exposure to lead from its ongoing addition to paint, Para-occupational exposure and its use in backyard 'cottage industries' will continue to be an important public health hazard in south Africa for decades. Young children, especially those from disadvantages communities, remain particularly vulnerable to lead exposure and poisoning.

According to Riddell et al. [14]Lead poisoning is one of the most significant environmental health threats children face. This paper describes the prevalence of lead poisoning among these children living in a rural area that covers about one third of the Philippines. In the study, it was found that 21% had blood lead level greater than 10µg/dl due to multiple sources like fossil fuel consumption, lead paint and house hold items.

Freije and Dairi [15] investigated the blood lead levels in adult citizens between the age group of 19-48 years. It was found that blood lead level in 72.5% of the participants was higher than the internationally accepted level. It may be because of use of leaded gasoline in automobiles. However, further investigations are required in to reveal the possible relationship between elevated blood lead levels and the immune system.

Yakub et al. [16] undertook a study to determine if petrol-pump workers in Karachi have high levels of blood lead and plasma homocysteine, and to find out the role of vitamins-folate, Bl2, B6 and C in influencing levels of blood lead and homocysteine in study population. In a comparative pilot study, 35 males working at petrol-pumps and 50 age-matched males working in the Aga Khan University (AKU) were enrolled. Fasting blood was analysed for lead, while plasma/serum was analysed for homocysteine, folate, vitamin-Bl2, pyridoxal phosphate (PLP, coenzymic form of vitamin-B6) and vitamin-C. Mean levels of blood lead in petrol-pump workers and AKU-employees were not found to be significantly different (12.9 ± 3.7 and 14.5 ± 6.1 µg/dl, respectively).

Al-Rudainy [17] carries out the research work to study the blood lead level among fuel station workers in Basrah (Iraq). It is found that the elevated blood lead levels among many fuel stations workers in Basrah and it is higher than the limit permitted by the World Health Organization. It is also reported that in addition to research, good health promotion and protection measures should be taken for fuel stations workers in Basrah.

Mogwasi et al. [18] studied the effect of occupation on the lead levels in human blood in Nairobi City and Nyamira District, Kenya. using atomic absorption spectroscopy and differential pulse anodic stripping voltammetry for determining the lead levels. The streethawkers in Nairobi City centre had the highest mean blood lead level of 36.85 ± 16.98 µg/dl followed by clerks (13.2+6.83 µg/dl) and teachers (8.1 ± 5.3 µg/ dl) in Nyamira Town. Those who worked in occupation such as driving/conducting of public vehicles, petrol station attending and street hawking had high blood lead levels than those who worked in occupations like teaching, farming, nursing and clerical jobs. The differences in the mean BLL of those involved in other occupation and the clerks was statistically significant ($p < 0.05$) for Nairobi City Centre, Nyamira Town and Nairobi Suburban.

Concluding Remarks

Looking to the harmful effect of lead on environment (air, water and soil) and health hazard for human being, numerous researchers carried out the work related with lead as reported above in literature review. Lead is one of the most abundant heavy metals and its toxic effects cause environmental and health problems because of its stability in contaminated site and complexity of mechanism in biological toxicity [19]. Through literature review, it is found that there is no direct work to study the lead pollution by determining the blood lead level for peoples of Bhopal city.

Lead possesses properties that make it attractive for use in numerous industrial processes, resulting in it becoming a common pollutant in environments around the world. Formerly an additive to both gasoline and paint, lead is particularly common in urban settings where years of use of these commodities have resulted in relatively high levels of lead in air water and soil. While useful for industrial purpose, lead possesses no known supplemental or nutritional values for humans. Even small quantity, lead displays toxic effects on almost every major organ system in the body. Environment pollution by lead is worldwide public problem, exemplified by a elevated blood levels among people living in the polluted areas [20]. Lead poisoning has adverse health impacts [21] Bhopal is situated in the heart of the country and capital of Madhya Pradesh. Millions of Peoples from all over the State and country and from abroad visit this place every year. Due to this transportation of people, environment is contaminated by lead from automobile emissions. Another thing, there are lots of industries. They release huge amount of gaseous as well as metallic pollutants, it is also a source of lead accumulation. Therefore, there is a need to study about some aspects of lead pollution in Bhopal city by knowing the blood lead level of peoples of city.

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