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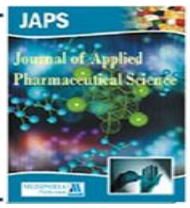

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Ameliorative effect of Docosahexaenoic acid and gamma-linolenic acid on blood glucose level in lead treated Swiss albino mice during gestation and lactation

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ABSTRACT

Numbers of studies in animal models have shown changes in blood glucose level after lead administration. In the present study, ameliorative effect of Docosahexaenoic acid (DHA) and Gamma-linolenic acid (GLA) on random blood glucose level of normal and lead exposed pregnant and lactating Swiss albino mice were compared. Pregnant females were exposed to heavy metal lead orally on diet containing 4.5% lead nitrate and 4.5% lead acetate trihydrate during gestation to 3rd week of lactation. Blood glucose level was examined on 15th day of gestation and 10th day of lactation. The results indicated that in lead intoxicated pregnant females, blood glucose level increased. It can be concluded that not only lead exposure during gestation can severely affect the growth and development of pups but can also produce adverse effect on one already having increased blood glucose or diabetes. DHA and GLA showed ameliorative effect on blood glucose level in Swiss albino mice.

Key words: Lead nitrate, Lead acetate trihydrate, Swiss albino mice, blood glucose level, gestation and lactation.

INTRODUCTION

It has been known since ancient times that lead may cause poisoning in man. In the modern era, thousands of hazardous chemicals and heavy metals are being produced and used in a wide variety of work places all over the world. Heavy metals are trace metals that are at least five times denser than water and are taken into body via inhalation, ingestion and skin absorption. It should be noted that most of the pathological conditions in body arise as a result of the exposure to these injurious substances. Lead and other heavy metals create reactive radicals which damage cell structure including DNA and cell membrane (Flora et al., 2008). Lead poisoning can cause a variety of symptoms and signs which vary depending on the individual and the duration of lead exposure (Karri et al., 2008; Kosnett, 2005). Gestational lead exposure has many adverse effects on development; a few of them may be most pronounced during the first trimester (Mogra et al., 2009) Many investigators studied the lower as well as higher exposure levels to lead. The amount of lead in blood and tissues, as well as the time course of exposure, determines the level of toxicity (Pearson and Schonfeld, 2003). Blood often shows pathological changes before the external signs of poisoning become apparent. The absorbed lead enters the blood stream where over 90 percent of it is bound to the red cells with a biological half life of 25-28 days (Azar et al., 1975).

Toxicological effects of lead have their origin in perturbation in cell function of various organ systems. The major biochemical effect of lead is its interference with heme synthesis which leads to hematological damage (Awad and William, 1997). Despite several published accounts on patho-physiological alterations of lead toxicity and the cure of lead poisoning by sequestering agents (Royce and Rosenberg, 1993), the approaches are limited in scope. The present investigation was focused to evaluate the blood glucose level during gestation and lactation period.

MATERIALS AND METHODS

Drugs and Chemical

Lead nitrate (Merck Specialities Pvt Ltd, Mumbai), Lead acetate trihydrate (Central Drug House Pvt Ltd, New Delhi), PRO-PL (British Biologicals, Bangalore). All the chemicals and solvents were of analytical grade.

Animals

Swiss Albino mice of either sex (young, age 10-12 weeks, 25-30g) were used for the study. Animals were housed in polypropylene cages and maintained under standard laboratory environmental conditions; temperature 25 ± 2ºC, 12h dark cycle and 50±15 relative humidity with free access to food and water ad libitum. Animals were acclimatized to laboratory condition before the test. Each group consisted of six (n=6) animals. All the experiments were carried out during light period (08:00-16:00). The studies were carried out in accordance with the guidelines given by Committee for the Purpose of Control and Supervision on Experiments on Animals (CPCSEA). The Institutional Animal Ethical Committee of Banathali University, Rajasthan approved the protocol of the study (Ref. No.IAEC/257).

Experimental method

Random breed Swiss albino mice were used for the present study. Sexually mature male and females weighing 25-30 gm were put in breeding cages in the ratio of 4:2 (4 female: 2 male) and were provided standard diet and water *ad libitum*. The cages were checked every day in the morning and females showing vaginal plug were isolated. The pregnant female was housed in an individual cage and was started on diet containing 4.5% lead nitrate and lead acetate trihydrate alone and with dietary supplement (containing DHA and GLA) respectively along water *ad libitum*. Comparable litters that received normal standard diet alone and with dietary supplement along water *ad libitum* were studied concurrently as controls.

Treatment groups

Animals were divided into 6 groups having 6 animals each.

Group I - Control
Group II - Control + Dietary supplement
Group II - Lead nitrate (4.5%)
Group IV - Lead nitrate (4.5%) + Dietary supplement
Group V – Lead acetate trihydrate (4.5%)
Group VI - Lead acetate trihydrate (4.5%) + Dietary supplement

During the respective tenure of experiment, blood glucose of female Swiss mice was recorded on 15th day of gestation and 10th day of lactation. Blood samples for blood glucose measurement were obtained from the tail of each mouse. The tip of the tail was cleaned with spirit before being cut with a sharp blade and was not squeezed to avoid dilution of blood by tissue fluid. The first drop of blood was discarded. The blood glucose was measured by Dr. Morepen Glucomonitor. The statistical analysis was performed by using analysis of variance (ANOVA) for the comparison of data between different experimental groups.

RESULTS

Introducing lead nitrate and lead acetate trihydrate to female Swiss mice during gestation and lactation period produced a significant increases the blood glucose level. Data regarding changes in blood glucose level among different experimental groups and the results obtained for blood glucose level, Tables 1. It is evident from the table that, DHA and GLA has ameliorative effect in reducing blood glucose level in Swiss albino mice.

Table 1. Blood glucose levels (mg/dL) in pregnant (prenatal) and lactating (postnatal) female Swiss albino mice treated with lead nitrate and lead acetate trihydrate.

Treatment Groups	Blood glucose (mg/dl)	
	Prenatal (15 day)	Postnatal (10 day)
Control	90.66 ± 4.36	94.02 ± 3.01
Control + Dietary supplement	85.42 ± 2.47	81.27 ± 2.42
Lead nitrate (4.5%)	116.78 ± 3.33[a]	107.56 ± 6.99[a]
Lead nitrate (4.5%) + Dietary supplement	94.02 ± 3.01	88.63 ± 5.61
Lead acetate trihydrate (4.5%)	110.25 ± 1.23[a]	102.25 ± 5.73[a]
Lead acetate trihydrate (4.5%) + Dietary supplement	92.33 ± 4.81	87.65 ± 3.89

Values were expressed as means ± S.EM; n=6; [a]P< 0.05 vs control group at the respective day; one-way ANOVA followed by Dunnett's multiple comparisions test.

DISCUSSION

In any living tissue toxic influences exert their effects first at the molecular and then at biochemical levels (Robbins and Angell, 1976). According to Harkness and Wagner (1993), mean hemoglobin levels for rodents vary from 10 to 17 g/dL. The alterations in hematological changes serve as the earliest indicator of toxic effects on tissue (Paprika and Sharma, 2003). Therefore in the present investigation, toxic effects of lead were evaluated by using blood glucose level as the hematological parameters. Anemia may result when the cell membranes of RBCs become more fragile as the result of damage to their membrane (Yu, 2005). Rugh and Somogyi (1969) reported that hemoglobin declines during the early postnatal period (a phenomenon referred to as physiological anemia). Some studies show that taking gamma linolenic acid (GLA) for 6 months or more may reduce symptoms of nerve pain in people with diabetic neuropathy. People who have good blood sugar control may find GLA more effective than those with poor blood sugar control.

CONCLUSION

The present study indicates that lead adversely affects blood glucose level, DHA and GLA has ameliorative effect.

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