Haemato-Biochemical Alterations induced by lead acetate toxicity in Wistar Rats

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Abstract

An experiment was conducted to study the haemato-biochemical alterations induced by lead acetate toxicity in 48 Wistar rats of either sex, divided uniformly into four different groups. The rats of group I received only deionised water as control while, group II, III and IV were given lead acetate @ 1 PPM, 100 PPM and 1000 PPM, in drinking deionised water respectively for 28 days. In group III and IV dose dependant significant ($P<0.05$) reductions in TEC, Hb, PCV and TLC were observed. No significant change was observed in neutrophil, eosinophil, basophil and monocyte count in any treatment groups, whereas the lymphocyte count decreased significantly ($P<0.05$) in group III and IV. A dose dependant significant ($P<0.05$) increase in AST, ALP, AKP, GGT, BUN and creatinine was experiential while TP and albumin levels were decreased in group III and IV.

Keywords: Biochemical, Haematology, Lead acetate, Wistar rats, Toxicity.

Introduction

In recent years, lead has become a regulatory concern and subject of much interest among pharmacologist, environmental scientist and clinicians because of its widespread distribution in environment due to its continuous emission from industrial sources, automobile exhaust and its pharmacological behavior to remain bound to mammalian tissues for a long duration (Freeman, 1970). Many reports are available regarding lead toxicity and its deleterious effects in various species of animals and there has been lot of work carried out on pharmacokinetics and genotoxicity but very few researcher tried to correlate haematobiochemical alterations of lead acetate at different dose levels in laboratory animals especially in rats as they considered as a suitable animal model.

Materials and Methods

The study was carried out on 24 male and 24 female rats randomly divided into 4 groups with six male and six female in each group. Animals of group II, III and IV were given lead acetate @ 1 PPM, 100 PPM and 1000 PPM in deionised drinking water, respectively while group I received only deionised water for 28 days. After 28 days of treatment with lead acetate, blood sample (1 ml) was collected from retro-orbital plexus with the help of capillary tube. Prior to blood collection rats were fasted for 12 hours. Blood was collected in two aliquots. In one aliquot, K_3 EDTA was added as anticoagulant and blood was collected and used for haematological estimation. In second aliquot, serum was harvested from anticoagulant free blood for biochemical estimation. Blood smears were also prepared for differential leukocyte count. Serum biochemical parameters were analyzed using Ecoline Kits (Merck Specialities Pvt. Ltd., Ambernath-421501) by auto serum analyzer (Selectra Junior, Merck Pvt. Ltd.). The data were analyzed using one way ANOVA by SPSS (Ver. 10.00).

Results and Discussion

Reduction in RBCs, PCV, Hb, MCV, MCH and MCHC (Table-1) was observd following exposure of lead acetate in rats of group III and IV which revealed microcytic hypochromic anemia. This haematological alteration might be due to effect of lead on activity of ä-aminolevulinic acid dehydratase (ALAD), key enzyme of heme synthesis. Moreover lead also inhibit the conversion of coproporphyrinogen III to protoporphyrin IX leading to reduction in haemoglobin production and shortened life span of erythrocytes (Klassen, 2001). Progressive destruction of RBCs due to binding of lead with RBCs, leading to increase fragility and destruction; could be another reason for decrease haematological

Table 1: Haematological values (Mean ± SE) of Wistar rats exposed with lead acetate.

Parameters	Group I (Control)	Group II((1 ppm)	Group III (100 ppm)	Group (1000 ppm)
TEC(10^6/µL)	8.01±0.15^a	7.99±0.18 ^{a}	6.97±0.10^b	5.99±0.12^c
Hb(g/dl)	16.36±0.46^a	16.04±0.58^a	12.21±0.14^b	9.47±0.17^c
PCV(%)	47.60±0.66^a	46.98±0.64^a	36.63±0.54^b	31.09±0.36^c
MCV(fl)	59.42±0.98^a	58.79±0.94^a	52.55±0.13^b	51.90±0.11^c
MCH(pg)	20.42±0.13 ^{a}	20.07±0.32^a	19.07±0.11^b	15.80±0.06^c
MCHC(%)	34.36±0.40 ^{a}	34.14±0.34^a	33.33±0.12^b	30.45±0.25^c
TLC($X10^3$/µl)	10.94±0.30 ^{a}	10.42±0.27^a	9.87±0.23^b	8.52±0.11^c
Differential Leucocyte count				
Neutrophils	19.21±0.18^a	19.11±0.20^a	19.02±0.21^a	19.01±0.28^a
Lymphocytes	72.34±0.15^a	72.14±0.17^a	70.33±0.11^b	70.12±0.09^b
Monocytes	5.44±0.50^a	5.40±0.47^a	5.82±0.25^a	5.99±0.31^a
Eosinophils	3.29±3.72^a	3.31±2.97^a	4.23±2.22^a	4.28±2.07^a
Basophils	0.50±0.22^a	0.40±0.21^a	0.60±0.12^a	0.60±0.17^a

Data followed by similar letter are not significantly differ (P<0.05).

values (Rous, 2000). Similarly significant decrease in Hb, PCV, MCH, MCV and MCHC were observed following exposure of rats to lead acetate. (Helmy *et al.,* 2000).

Analysis total leucocytes count and differential leucocyte count revealed leucopenia and lymphopenia (Table 2) in higher dose group. This might be due to direct toxic action of lead on leucopoiesis in lymphoid organs. Decrease in TLC is directly related with either their decreased production from the germinal center of lymphoid organs or increased lysis due to presence of lead in the body (Avdheshkumar *et al.,* 1998).

In the present study, increased in AST and ALT was observed in group III and IV, which might be due to increased cell membrane permeability or cell membrane damage of hepatocytes caused by lead acetate. These findings are in accordance with Shalan *et al.* (2005). Amongst all treatment groups increase in AKP was highest in group IV followed by group III as compared to control group. The increase in AKP might be due to the damage of liver, kidney and bone resulting into liberation of AKP. (Kaplan and Reghetti, 1970). Increase in AKP level observed in the present study is in agreement with the findings of Shalan *et al.* (2005). The mean GGT levels were increased in group III and IV compared to control group. Increase in GGT is an indication of hepatotoxicity and oxidative damage in the hepatocytes. (Tatjana *et al.,* 2003).

Elevation of BUN and Creatinine was observed in group III and IV. Increase in creatinine concentration might be due to loss of 50 % of kidney function and considered as functional evidence of lead induced nephrotoxicity (Qu *et al.,* 2002). However significant decrease in Creatinine and BUN was reported in lead acetate treated rats. (Rumana *et al.,* 2002). Decrease in total protein and albumin in group III and IV revealed compared to alteration in protein patterns which might be due to binding of lead to albumin. (Stone and Soares, 1976). In conclusion, lead exposure at the levels of 100 PPM and 1000 PPM in drinking deionised water leads to toxicity in Wistar rats.

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Table 2: Serum biochemical parameters (Mean ± SE) of Wistar rats exposed with lead acetate.

Parameters	Group I (Control)	Group II (1 ppm)	Group III (100 ppm)	Group (1000 ppm)
AST (IU/L)	134.76±1.98[a]	137.36±2.41[a]	151.35±2.75[b]	165.23±1.07[c]
ALT (IU/L)	59.43±5.80[a]	66.24±2.30[a]	108.43±3.80[b]	148.24±4.30[c]
AKP (IU/L)	67.56±3.12[a]	71.27±2.10[a]	134.85±2.13[b]	153.12±1.78[c]
GGT(IU/L)	9.16±0.92[a]	9.97±0.23[a]	14.95±0.10[b]	17.31±0.27[c]
Creatinine(mg/dl)	0.95±0.02[a]	1.02±0.08[a]	1.41±0.06[b]	1.62±0.08[c]
BUN (mg/dl)	17.97±2.98[a]	18.67±1.08[a]	23.72±1.11[b]	27.56±1.04[c]
Total Protein (g/dl)	7.69±0.03[a]	7.61±0.05[a]	6.76±0.02[b]	5.83±0.03[c]
Albumin (g/dl)	4.78±0.05[a]	4.72±0.04[a]	3.89±0.04[b]	3.02±0.03[c]
Globulin (g/dl)	2.91±0.02[a]	2.89±0.04[a]	2.87±0.05[a]	2.81±0.04[a]

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