Patho-morphological changes in tissues of Wistar rats by exposure of Lead acetate

S. G. Suradkar, P. D. Vihol, J. H. Patel, D.J.Ghodasara, B.P. Joshi and K.S. Prajapati

Department of Veterinary Pathology,
College of Veterinary sciences and A.H., Anand Agricultural University, Anand- 388001

Abstract

The study was carried out to evaluate pathomorphological changes induced by lead acetate toxicity in 48 wistar rats which were uniformly divided into four different groups. The group I received only deionised water as control while, group II, III and IV rats were given Lead acetate @ 1, 100 and 1000 PPM respectively in drinking water for 28 days. After 28 days of treatment with lead acetate, rats were sacrificed. The lesions were characterized by degeneration, necrosis, cellular and vascular changes. The main target organs affected were kidney, liver and testes. The overall lesions gave impression that lead is hepatotoxic as well as nephrotoxic in nature. The intensity and distribution of such lesions were found more severe in rats of group IV, followed by rats of group III.

Key words: Pathomorphological effect, Lead acetate, Wistar rats

Introduction

Health problems has been widely reported due long–term ingestion of contaminated drinking water with heavy metals like lead and arsenic. Among heavy metals lead is the most ubiquitous common pervasive environmental pollutant having diverse and deleterious effects on man and animals health. Lead induces a wide range of physiological, biochemical and behavioral dysfunctions. Main target organs of lead toxicity are kidney, liver, spleen and testes. Many reports are available regarding lead toxicity and its deleterious effects in various species of animals but very few researchers tried to correlate pathomorphological changes of lead acetate at different dose levels in laboratory animals especially in rats as they considered as a suitable animal model.

Materials and Methods

Assessment of sub acute lead acetate toxicity was carried out on 24 male and 24 female rats randomly divided into groups I, II, III and IV (6 male and 6 female rats in each group). Animals of group II, III and IV were given lead acetate @ 1, 100 and 1000 PPM in deionised drinking water, respectively while group I received only deionised water for 28 days. Body weight of groups I to IV rats was taken initially on day 0 and then on 7th, 14th, 21st and 28th day of experimental period. After 28 days of treatment with lead acetate, rats were sacrificed. At postmortem examination gross lesions were noted and tissues obtained for histological evaluation included liver, lung, heart, kidney, brain, spleen and intestine. All tissues were placed in 10% buffered formalin, then embedded in paraffin, and stained with hematoxylin and eosin (H&E).

Results and Discussion

No significant reduction was observed in body weight of male and female rats up to 7th day. The dose dependant significant ($P<0.05$) decreases in body weights for both sex were observed in group III and IV from 14th day onwards. Highest reduction of body weight of male and female rats was obsereved at 28th day in group IV followed by group III as compared to control group. (Table-1 and 2). Similar findings coincided by Shakoor *et al.* (2000) and Chen *et al.* (2004).

Male and female rats of group I and II did not reveal any clinical symptoms through out study period. From 21st day of experiment, toxic symptoms like weakness, lethargy, pale mucous membrane and diarrhoea along with respiratory distress were noticed in some of the male and female rats of group III and IV.

Grossly liver was enlarged, pale and friable in rats of group III and IV. Histopathologically, lesion characterized by engorgement of blood vessels along with sinusoidal hemorrhages, perivascular mononuclear cell infiltration, dilatation of central veins, vacuolar degeneration of hepatocytes and increased cytoplasmic eosinophilic granularity in group III rats. Sections of liver from group IV showed swelling of

Table 1: Weekly body weight (Mean ± S.E., g) in male rats of different experimental groups (n = 6 rats).

Group/No.	Days				
	0 day	7th day	14th day	21st day	28th day
I	299.5±2.43[a]	310.2±4.78[a]	313.2±2.12[a]	335.2±3.09[a]	350.1±9.11[a]
II	300.3±1.21[a]	306.3±4.39[a]	312.4±2.12[a]	332.9±6.45[a]	342.3±8.61[a]
III	302.4±3.23[a]	301.1±5.22[a]	290.4±9.40[bc]	281.8±6.45[bc]	270.4±3.32[b]
IV	305. 7±4.75[a]	299.7±8.99[a]	281.5±8.97[c]	275.2±6.87[c]	262.3±3.38[c]

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

hepatocytes with the variable degree of nuclear changes (like karyolysis, karyorrhexis and pyknosis), distortion of hepatic chords and areas of diffused vacuolar and granular degeneration. In few cases increased eosinophillic granularity of hepatocyte cytoplasm and diffuse infiltration of mononuclear cells around the portal triads and in parenchyma was observed. Similar hepatotoxicity lesions were also reported by Banu and Sharma, (2005) and Shalan *et al.* (2005). The pathomorphological lesions in liver may be due to the action of lead on hepatic glycogen, DNA content and the ability to incorporate amino acid into protein. (Barrat *et al*., 1989). Rats of group II did not show any specific histopathological and gross changes.

No appreciable gross and microscopic lesions were seen in kidneys of group II. Severity of lesion were more pronounced in group IV in comparing to group III and characterized by easy peeling of capsule with no adhesions, marked congestion and mild enlargement with bulged edges. Histopathologically kidney section of group III showed mild granular and vacuolar degeneration in tubular epithelial cells with focal necrosis, MNC's infiltration in interstitial space and increased periglomerular space. In group IV there were severe congestion, haemorrhages, degeneration and necrosis of tubular epithelium with pink staining proteinous debris in the lumen and foci of mononuclear cells infiltration in the cortex. But, the intensity of lesions was less in group III as compared to group IV. Nature of degeneration and vascular changes in the kidney due to toxicity of lead were also reported by various researchers (Qu, *et al.* 2002 and Siddiqui *et al.* 2002). Accumulation of lead-protein complex which causes discernible changes in proximal tubular linings of cells can be reason for lead toxicity in kidney (Goyer, 1988).

In intestine, there was no gross pathomorphological alteration observed in group II. The lesions observed in rats of group III and IV were mild to severe congestion and erosion of intestinal mucosa. While, microscopic lesions like desquamation and denudation of surface epithelium, erosion, ulceration and necrosis of intestinal villi with diffuse mononuclear cells infiltration in mucosa and submucosa were noticed. Intestinal lesions of lead might be due to their irritative action on mucosa of intestine (Ochiai *et al.* 1999).

In lung, no significant gross changes were observed in low dose level group. Lesions in lung were mainly characterized by mild to moderate congestion, haemorrhages and emphysema in rats belonging to group III and group IV. Microscopically, lesions in lungs of group III and IV rats were characterized by congestion, haemorrhages, emphysema and infiltration of MNC in few cases. Some of the rats of group IV, showed sever infiltration of MNCs in interstitial spaces. Oyeronke *et al.* (2007) observed focal haemorrhages in lungs by exposure of lead in rats.

In any of the treatment group, no gross pathological lesions were observed in spleen except mild congestion and enlargement in group IV. Microscopically observed lesions were depletion of lymphoid cell population, atrophic splenic follicles with mild follicular activity, degeneration and necrosis of the lymphoid cells were observed. The intensity of lesions was more pronounced in group IV as compared to group III. Present findings are in agreement with those reported by Chauhan *et al*. (1995).

Gross changes in heart were observed only in group IV, which showed very mild congestion. Microscopically rats of group IV revealed focal areas of congestion and haemorrhages in interstitium of cardiac muscles.

Macroscopically, testes of rats (group IV) were

Table-2. Weekly body weight (Mean ± S.E., g) in female rats of different experimental groups (n = 6 rats).

Group/No.	Days				
	0 day	7th day	14th day	21st day	28th day
I	199.6±5.13[a]	207.2±5.10[a]	221.5±4.81[a]	234.5±7.89[a]	239.6±4.71[a]
II	199.5±5.16[a]	204.7±4.78[a]	211.6±6.08[a]	215.5±5.20[b]	215.8±4.03[b]
III	197.6±7.58[a]	195.5±6.08[a]	193.8±8.88[bc]	191.3±5.98[cd]	181.4±3.14[c]
IV	198.6±5.65[a]	197.9±5.14[a]	186.3±7.98[c]	185.8±6.05[d]	172.1±.4.16[d]

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

found, atrophied as compared to rats of control (group I). Where as engorged blood vessels were seen on testes of group III. Microscopically, in group III rats, mild to moderate congestion, atrophy of seminiferous tubule, necrotic cell debris in lumen and intertubular edema were noticed. Testes of group IV rats showed discernible changes like disorganization and disruption of spermatogenesis with accumulation of immature cells in lumen of tubules. Spermatids were the most affected germ cells and were absent in few tubules leading to emptying of tubules. In some tubules, formation of multinucleated giant cells was recorded along with degeneration and necrosis of the seminiferous tubules. However, the lesions were prominent in group IV in compared to group III. Chung *et al*. (2001) also reported atrophy and necrosis of seminiferous tubules in cauda epididymis on lead exposure in male mice.

Acknowledgement

The authors are thankful to Anand Agricultural University for providing infrastructure for this research.

References

1. Banu, R. and Sharma, R. (2005): Protective effect of vitamins (C and E) on lead induced hepatotoxicity in male swice mice. *Journal of Cell and Tissue Research*, 5 (1) : 293-298.
2. Barrat, C. L. R.; Davies, A. G. and Bansal, M. R. (1989): The effects of lead on the male rat reproductive system. *Andrologia.* 21: 161 – 166.
3. Chauhan, R.S.; Khurana, S.K. and Mahipal, S.K. (1995): Pathology of chronic lead poisoning in chicken. *Ind. J. Toxicol.* 2:56.
4. Chen, S. P.; et.al.(2004): Developmental immunotoxicity of lead in the rat: influence of maternal diet. *Journal of Toxicology and Environmental Health part-A*, 67(6): 495-511.
5. Chung, T. L., Lai, J. S., Liao, J., and Wang, S. C. (2001): Lead toxicity in ICR mice. J. of Chinese Society of Vet. Sci. 28(1): 104 – 112.
6. Goyer, R. A. (1988): Mechanisms of lead and cadmium nephrotoxicity. Toxicol Lett. 46 (1-3): 153-62.
7. Ochiai, K.; Kimura, T.; Uematsu, K.; Umemura, T. and Itakura, C.(1999): Lead poisoning in wild waterfowl in Japan. *J. of Wildlife Diseases.* 35(4): 766-769.
8. Oyeronke, A.O.; Kazeem, A. A.; Babatunde, O. and Oladimeji, T. (2007): Interaction and enhancement of the toxic effect of sodium arsenite and lead acetate in Wistar rats. *African J. of Biomedical Res.* 10 : 59-65.
9. Qu, W.; et.al. (2002): The metallothionein-null phenotype is associated with heightened sensitivity to lead toxicity and an inability to form inclusion bodies. American Journal of Pathology. 160 (3): 1047-1056.
10. Shakoor, A.; Gupta, P. K.; Kataria, M. and Dwivedi, S. K. (2000): Effect of simultaneous exposure to aluminium and lead on growth in male albino rats. Indian J. Toxicol., 7 (2): 51-56.
11. Shalan, M.G. et.al.(2005): Amelioration of lead toxicity on rat liver with vitamin C and silymarin supplements. Toxicology, 206 : 1-15.
12. Siddiqui, R.; Mishra, G.V. and Vohora, S.B. (2002): Effect of therapeutic doses of calcined arsenic and lead prepations in rats. *Ind. J. Vet. Pathol*. 26 (1 & 2): 81-82.

* * * * * * * *