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Chronic Effects of Mercuric Chloride Ingestion on Rat Adrenocortical Function

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Mercurial contamination of environment has increased (Joensuu 1971; Wallace et al. 1977). Mercury accumulates in various organs and adversely affects their functions (Olwin 1977). Some of the most prominent toxic effects of inorganic mercury compounds include neurotoxicity (Bondy and Agrawal 1980), hepatotoxicity (Piotrowski et al. 1974) and nephrotoxicity (Brunner et al. 1985). Besides this, mercury has also been reported to affect various endocrine glands like pituitary (Clifton et al. 1986), thyroid (Nishida et al. 1986), gonadal (Roy Chowdhury et al. 1986) and adrenal glands (Burton and Meikle 1980). There have been no reports on the toxic effects of chronic oral administration of varying doses of mercuric chloride on adrenocortical function in albino rats. The present work was undertaken to study the adrenocortical response to chronic oral administration of mercuric chloride of varying dose and duration in albino rats.

MATERIALS AND METHODS

Sixty adult male albino rats (Charles-Foster strain) weighing 100±10 g were used in this study. They were kept in polypropylene cages (5 rats in each cage) and fed standard laboratory chow (Hindustan Lever Limited) and tap water ad libitum. Rats were acclimatized to standard laboratory conditions one week before starting the experiment. Rats were divided into four groups. Group I rats received tap water throughout the study and served as the control group. Rats in groups II, III and IV received 25 ppm, 50 ppm and 100 ppm of mercuric chloride in drinking water. Sixty, 120 and 180 days during the treatment, 5 rats of each group were removed for time studies. An equal number of rats from each group were anaesthetized with i.p. Pentobarbitone sodium (40 mg/Kg) at the termination of each stage. Cardiac puncture was affected through an abdominal incision and the blood was collected in heparinized glass syringes. Samples were removed at the same time of the day in all groups. Plasma was separated by centrifugation and stored at O°C. Immediately following blood collection, the rats were decapitated and their adrenal glands removed and stored at O°C prior to assay. The adrenal and plasma were used for the estimation of plasma corticosterone (Mattingly 1962) and adrenal corticosterone (Silber et al. 1958). All reagents used in the assays were

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of analytical grade. The data was statistically analysed using the Student's 't' test.

RESULTS AND DISCUSSION

Due to large amounts of the organic mercurial compounds in industrial wastes, considerable information has been accumulated regarding their toxic effects on biological systems. There have been no reports on the effect of inorganic mercury on the adrenocortical function in albino rats. In the present study, rats of group II, III and IV showed a significant increase in the adrenal weight up to 180 days as compared to controls (Table 1).

Table 1. Changes in adrenal gland weight (mg/100 g body weight) following administration of different doses of mercuric chloride; Mean±S.D.

Groups $HgCl_2$	Duration 60 days	120 days	180 days
I (Control)	11.56±0.59	11.64±0.37	11.62±1.20
II (25 ppm)	15.12±0.58**	13.82±0.97**	13.30±0.60*
III (50 ppm)	15.53±0.64**	12.86±1.09*	15.10±1.14**
IV (100 ppm)	14.70±0.36**	17.52±0.36**	15.22±0.41**

*$p < 0.05$, **$p < 0.01$

Similarly, the adrenal corticosterone levels were also found to be increased significantly in rats treated with different doses of mercuric chloride in a dose and duration dependent manner. Accordingly, the corticosterone levels increased progressively with increasing dose and duration of exposure up to 120 days. After 180 days, the adrenal corticosterone levels decreased in all mercuric chloride treated animals and returned to near normal values (Table 2). Similarly, the rats of group II fed lower dose of mercuric chloride (25 ppm) showed an increase in circulating corticosterone levels up to 120 days. After 120 days, the levels returned to near normal values. On the other hand, the rats of group III and IV treated with higher doses of mercuric chloride (50 ppm and 100 ppm) showed a significant reduction in plasma corticosterone at the end of 60 days followed by an increased in the levels at 120 days interval. Again after 180 days, the rats ingesting higher doses of mercuric chloride (50 ppm and 100 ppm) showed a decline in the levels of plasma corticosterone (Table 3).

This could possibly be ascribed to the development of resistance to this heavy metal, since, several experimental studies have demonstrated that animals develop tissue resistance following repeated exposure to certain chemicals (Balazs 1974). In case of nephrotoxic effects

Table 2. Changes in adrenal corticosterone (μg/g wet weight of tissue) in rats exposed to different doses of mercuric chloride; Mean±S.D.

Groups $HgCl_2$	Duration 60 days	120 days	180 days
I (Control)	34.20±7.62	39.59±5.39	36.53±5.54
II (25 ppm)	84.30±1.64**	125.81±40.0**	30.18±4.25^{NS}
III (50 ppm)	87.86±13.60**	163.49±20.2**	35.00±2.24^{NS}
IV (100 ppm)	103.49±22.1**	186.94±30.0**	30.56±4.59^{NS}

NS $p < 0.2$ Not significant, *$p < 0.05$. **$p < 0.01$

Table 3. Alterations in plasma corticosterone levels (μg/100 ml plasma) in mercuric chloride treated rats; Mean±S.D.

Groups $HgCl_2$	Duration 60 days	120 days	180 days
I (Control)	27.55±6.44	30.01±4.09	26.00±3.76
II (25 ppm)	36.66±1.11*	56.17±5.00**	19.57±5.97^{NS}
III (50 ppm)	19.07±2.891	42.64±2.90**	22.22±1.46^{NS}
IV (100 ppm)	11.11±1.11**	36.13±3.54*	26.60±1.37^{NS}

NS $p < 0.2$ Not significant, *$p < 0.05$, **$p < 0.01$

of mercury it is well documented that, in acute situations mercuric chloride induced renal failure but its repeated administration failed to knockdown the kidneys (Kluwe 1981 and 1982). Burton and Meikle (1980) reported adrenal dysfunction in rats treated with methyl mercury for 6 weeks. In their investigation the basal serum corticosterone levels were similar in controls as well as treated animals. Following exposure to stress, however, the treated animals exhibited a subnormal response with regard to the increase in serum corticosterone levels. To the contrary we observed an increase in the basal plasma and adrenal corticosterone levels following chronic administration of mercuric chloride up to 120 days. In view of this, it appears that the organic and inorganic compounds of mercury affect adrenocortical function in a different manner depending on the dose, duration and mode of administration of mercurials.

The observations recorded in the present study tend to suggest that

possibly mercuric chloride acts as a chemical stressor in a dose and duration dependent manner as evidenced by the increased adrenal and plasma corticosterone levels in treated rats.

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