Quantitative and Histological Study of the Effect of Cadmium Oxide on Both Body and Kidney of Mice

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Abstract

The present study was conducted using 24 normal male of Swiss white mice weighing (36-40 gm), 70 days old .The mice were divided into four groups of six mice each. The mice of control group were fed pellet and given tap water during the entire period of the experiment (30 days).The other three groups of mice were given cadmium oxide orally at doses of (7.0 mg / kg body wt., 14.1 mg / kg body wt., and 22.3 mg / kg body wt.) consecutively every day for 30 days and weight in gm was taken once a week. With standard histological techniques, samples were obtained from kidney of the mice. The body weights along with kidney weights were decreased with increase of doses. Also it has been concluded that cadmium oxide caused damages in renal corpuscle (Bowman's capsule and glomerulus) and renal cortical tubules as well as decrease in body weight and kidney weight (wt.).

***Key words**: cadmium, body weight, histological alteration, kidney, mice.*

Introduction

The mammalian kidney both anatomically and functionally is extremely complex organ and it plays an important role in the control and regulation of homeostasis. Heavy metals occur naturally in the environment and are found in varying levels in the ground. Cadmium is ubiquitous environmental pollutant, toxic element; enter the human body via food [1, 2]. Cadmium is absorbed rapidly, toxic to several tissues and accumulated in the liver and kidney [3, 4], which resulted in the reduced availability of cadmium to such organs as the kidney [5].

Therefore, the present study was designed to examine the effect of cadmium oxide on male mice body weight along with kidney weight quantitatively and to determine whether or not cadmium oxide can cause histological alterations which may affect kidney functions.

Materials and Method

Twenty four normal male of Swiss white mice were used in this experiment. They were 70 days old, weighing (36-40gm), and divided into four groups of six mice each. The mice of control group were fed pellet and given tap water during the entire period of the experiment (30 days). The other three groups of mice were given cadmium oxide orally at doses of (7.0 mg / kg body wt., 14.1 mg / kg body wt., and 22.3 mg / kg body wt.) consecutively every day for 30 days and weights in gram of the mice body were taken once a week. After the end of the experiment (30 day), the initial and final weights of mice in each group were taken, and, then, the mice were sacrificed and the kidney was removed and perfused with normal saline and the weights of kidney of treated groups along with control were also taken. Kidney was excised, fixed in 10% formalin. After fixation, the kidney was processed; wax block and slides were prepared then stained in Hematoxylin / Eosin for histological studies [6].

Results and Discussion

The mice kidney of the second group which was given a dose of 7.0 mg / kg body wt. of cadmium oxide ,showed histological alterations but there was no significant ($p > 0.05$) change in body weight and kidney weight while there was a significant ($p < 0.05$) loss in body weight and kidney weight treated with (14.1 mg / kg body wt. and 22.3 mg / kg body wt.) as shown in Tables (1 and 2). The intake of fed and water by treated group reduced as compared to control and the decrease was dose dependent.

Table 1: Showing the effect of cadmium oxide on body weight of male mice.

Group	Initial body weight/gm.	Final body weight/gm.	P value
Control (First)	36.1 ± 1.9	38.3 ± 2.1	-
7.0 mg / kg body wt. (Second)	36.7 ± 2.2	35.1 ± 2.5	P > 0.05
14.1 mg / kg body wt.(Third)	36.3 ± 3.1	33.2 ± 2.6	P< 0.05
22.3 mg / kg body wt.(Fourth)	37.1 ± 2.7	29.3 ± 2.9	P< 0.05

Table 2: Showing the effect of cadmium oxide on kidney weight of male mice.

Group	Kidney weight/gm.	P value
Control (First)	0.63 ± 0.02	
7.0 mg / kg body wt. (Second)	0.61 ± 0.01	P >0.05
14.1 mg / kg body wt. (Third)	0.52 ± 0.01	P< 0.05
22.3 mg / kg body wt. (Fourth)	0.43 ± 0.01	P< 0.05

Histological observations of kidney after different doses of cadmium oxide treatment showed degenerative alterations. The kidney of control group of mice showed normal architecture (Figure 1). With a dose of 7.0 mg / kg body wt., the observations of the kidney of the second group of mice showed congested glomerulus and blocked lumen of renal cortical tubules due to some necrosis (Figure 2) as compared to control. With a dose of 14.1 mg / kg body wt., the observations of the kidney of the third group of mice showed damaged glomerulus and dark appearance of renal cortical tubules (Figure 3), whereas with a dose of 22.3 mg/kg body wt., the observations of the kidney of the fourth group of mice showed disappearance of the kidney glomerulus due to destruction and the lumen of renal cortical tubules was widened, besides , the cells of renal cortical tubules were damaged that they were hardly distinguishable due to negative effects of cadmium oxide (Figure 4).

Metal can enter proximal tubular cells by endocytosis following binding of metal itself or a metalloid protein complex to the brush border membrane [7]. Once inside the cell, the metal can be released from the protein metal complex by lysosome degradation. The intracellular distribution of the metal then depend on the presence of various high – affinity binding sites or sinks within the cell [8] . The binding of metal glomerular basement membrane has been reported by [9]. Ionic blocking of these site leads to the loss of selectivity infiltration of albumin [10]. The cytosolic protein might be a fragment of the renal basement membrane and the determination of acute toxicity is usually an initial screening step in the assessment and evaluation of toxic characteristics of all compounds [11]. Lastly, we have presented evidences that necrotic is an important and predictable event of effect of cadmium. In conclusion, it seems reasonable to consider that the present study provided evidences

regarding degenerative changes in the architecture of the mice kidney due to harmful effects of cadmium oxide.

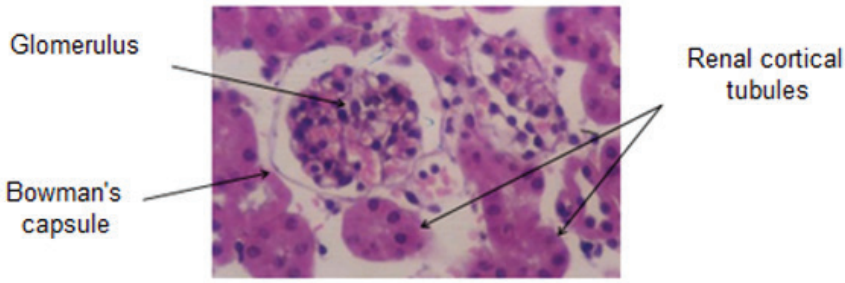

Figure 1: Showing normal architecture of kidney in control group of mice. H&E., 40X

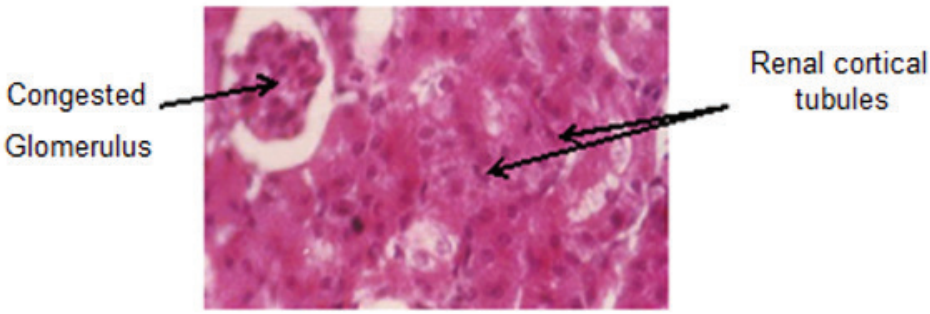

Figure 2: Showing congested glomerulus and blocked lumen of renal cortical tubules due to necrosis at a dose of 7.0 mg / kg body wt. cadmium oxide H & E., 40X.

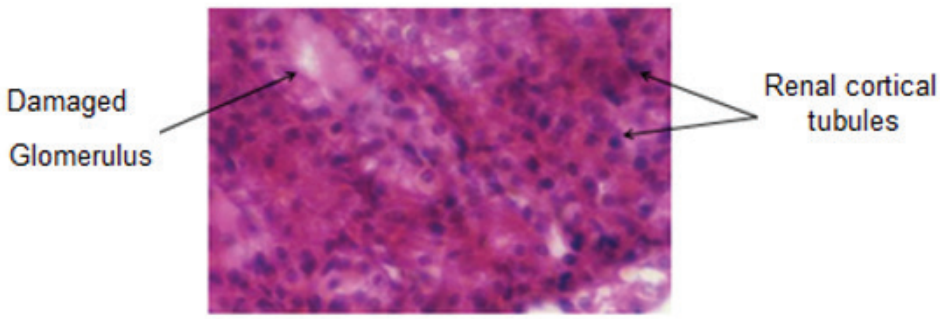

Figure 3: Showing damaged glomerulus and dark appearance of renal cortical tubules, at a dose of 14.1 mg / kg body wt. cadmium oxide H&E., 40X.

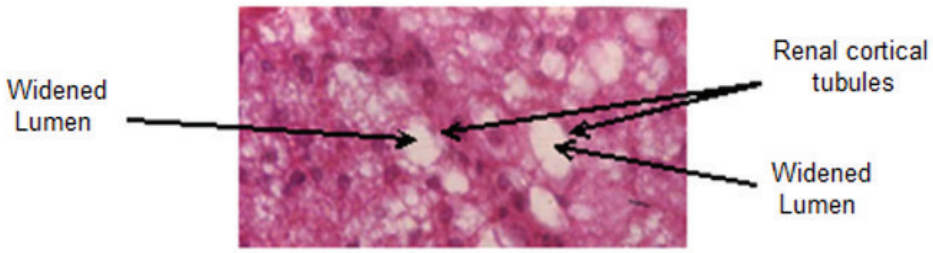

Figure 4: Showing disappearance of the kidney glomerulus due to destruction and both widened lumen and damaged cells of renal cortical tubules at a dose of 22.3 mg / kg body wt. cadmium oxide H&E., 40X. .

Conflict of Interest: The authors declare that they have no conflict of interest

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