



## Histological Changes in The Liver of Mice Treated with Cadmium

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### Abstract

The present study was conducted using 15 adult male Swiss albino mice (weighing 35-45g). They were equally divided into three experimental groups. The first group was only given water as control during experimentation period (28 days). Both of the second and third groups of mice were daily given a subcutaneous injection of cadmium as cadmium chloride ( $CdCl_2$ ) at a dose of 2mg and 4 mg Cd/Kg body weight respectively. The examination of the histological sections of the second experimental group of mice showed abundant histological changes in the hepatocytes such as increased size, presence of spaces and dense appearance of the cytoplasm, whereas these changes were more abundant in the hepatocytes of the third experimental group of mice in comparison with the second experimental group such as increased size and tubular-shaped hepatocytes, presence of spaces and dense appearance of the cytoplasm.

**Keywords:** Cadmium, Liver, Mice.

### التغيرات النسجية في كبد الفئران المعاملة بالكاديوم

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قسم العلوم الأساسية، كلية طب الأسنان، جامعة بغداد، بغداد، العراق

### الخلاصة

أجريت هذه الدراسة على خمسة عشر فأراً بالغاً من الذكور تراوحت أوزانها بين 35-45غم. قسمت الحيوانات الى ثلاثة مجاميع بواقع خمسة فئران للمجموعة. المجموعة الأولى كانت بمثابة مجموعة السيطرة حيث شربت الماء طوال فترة الدراسة البالغة (28) يوم. تم اعطاء فئران كل من المجموعة الثانية والثالثة حقنة يومية من الكاديوم ( $Cd$ ) تحت الجلد على شكل كلوريد الكاديوم ( $CdCl_2$ ) (2mg و 4mg/كجم) من وزن الجسم على التوالي. أوضحت نتائج فحص المقاطع النسجية لفئران المجموعة الثانية تغيرات نسجية واضحة في الخلايا الكبدية كزيادة حجم الخلايا، وجود كل من الفراغات والمظهر الكثيف للسايتوبلازم بينما كانت هذه التغيرات في الخلايا الكبدية لفئران المجموعة الثالثة أكثر وضوحاً مقارنة بفئران المجموعة الثانية كزيادة حجم الخلايا الكبدية واتخاذها شكلاً أنبوبياً وكذلك وجود كل من الفراغات والمظهر الكثيف للسايتوبلازم

## Introduction

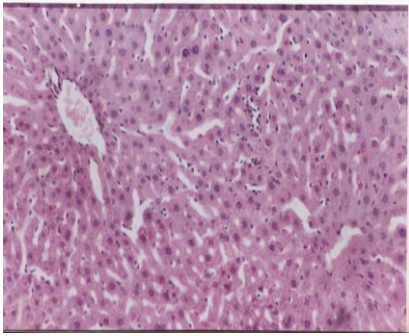
Cadmium (Cd) is a heavy metal which causes concern as an environmental toxicant [1]. The two major routes of cadmium exposure for humans in the general population are inhalation, primarily as CdO, and ingestion, primarily as CdCl<sub>2</sub> in contaminated water or food [2]. Cigarette smoke is the largest source of cadmium exposure outside of occupational settings [3]. Cadmium toxicity may be more common among natural populations of vertebrates than has been appreciated to date and that cadmium toxicity may often go undetected or unrecognized [4,5]. Quantifying the transfer of cadmium from foods to mammalian target organs is a key to estimating the health risk from this exposure; however, the bioaccumulation of cadmium is modified by many dietary components. Studies of dietary cadmium absorption would be simpler if it was known that cadmium added to foods as a soluble salt was as bioavailable as cadmium incorporated during growth of the food species [6]. Problems with cadmium were studied by many authors in humans [7,8], rabbits [6,9], frogs [10], rats [11,12] and wild animals [4,13,14,15,16,17]. There are also observed negative cadmium effects on the reproductive organs. The element induced follicular atresia in the ovary [12], degenerative alterations in the testes [18,19] and decreased spermatozoa motility [20,21]. Cd exposures have been linked to toxic effects in a number of the organ systems, such as liver and cardiovascular systems [22,23,24]. Cd has high influence in inducing toxicity over lungs, skeletal muscles by causing edematous emphysema, osteoporosis and osteomalacia, brain edema and hemorrhage and blood-brain barrier disruption [25,26]. Carcinogenic damage was observed in the lungs in Cd-exposed workers [27]. Cd may also contribute towards endothelial damage either directly by interacting with the endothelium or by inducing the generation of reactive oxygen species in endothelial and inflammatory cells [27]. Cd concentrates in the kidney, particularly inducing proteinuria and renal dysfunction; it is associated with hypertension [28]. The goals of the present work were to evaluate the effects of cadmium on mice liver and to determine whether or not cadmium can induce histological changes which could alter liver functions.

## Materials and Methods

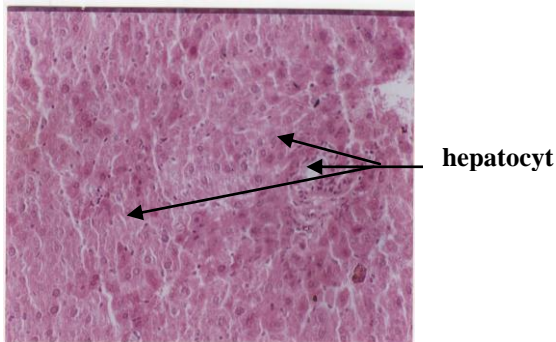
In the present investigation, 15 adult male mice were used (weighing 35-45g) which were divided into three equal experimental groups. Mice were maintained in plastic cages and allowed free access to standard laboratory food and tap water. The first group of mice which served as control group drank only water during the entire period of experimentation (28days). The second group of mice was daily given a subcutaneous injection of cadmium as cadmium chloride (CdCl<sub>2</sub>) at a dose of 2mg Cd/Kg body weight while the third group was daily given a subcutaneous injection of cadmium as cadmium chloride (CdCl<sub>2</sub>) at a dose of 4mg Cd/Kg body weight. Twenty-four hours after injection of last dose, two animals from each group were sacrificed (the other three mice from each group were kept in case of necessity). Livers were excised and subsequently fixed in 10% formalin overnight. After fixation, the livers were processed, wax block and slides were prepared then stained in haematoxylin and eosin for histological studies [29]. Histological sections were examined by light microscope and photographed at a magnification of 40X.

## Results

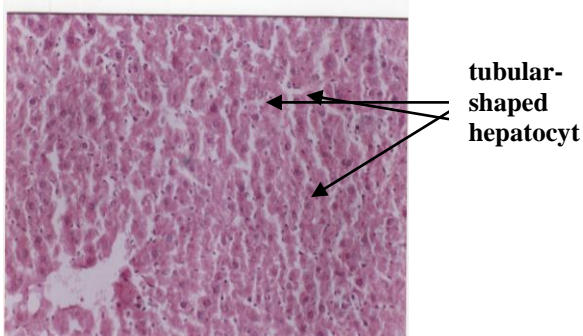
In the present work, the examination of the histological sections of the first group of mice (control) showed no histological changes in the liver of mice Figure 1 On the other hand, the examination of the histological sections of the second experimental group of mice given a subcutaneous injection of cadmium at a dose of 2 mg Cd/Kg showed abundant histological changes in the hepatocytes such as increased in size, presence of spaces and dense appearance of the cytoplasm Figure 2 while the examination of the histological sections of the third experimental group of mice given a subcutaneous injection of cadmium at a dose of 4mg Cd/Kg showed more abundant histological changes in the hepatocytes when compared with the second group of mice such as increased size and tubular-shaped hepatocytes, presence of spaces and dense appearance of the cytoplasm Figure 3 .



**Figure 1:** Transverse section of hepatic tissue in control group of mice showing normal hepatocytes. Stain: Haematoxylin & Eosin 40X



**Figure 2:** Transverse section of hepatic tissue in second group of mice showing abundant histological changes in the hepatocytes such as increased size, presence of spaces and dense appearance of cytoplasm. Stain: Haematoxylin & Eosin 40X



**Figure 3:** Transverse section of hepatic tissue in third group of mice showing more abundant histological changes in the hepatocytes such as increased size and tubular-shaped hepatocytes, presence of spaces and dense appearance of cytoplasm. Stain: Haematoxylin & Eosin 40X

**Discussion**

According to Aranami *et al.* [30], Cadmium (Cd) is one of the most toxic metals observed in nature. The results of the present study are consistent with the previous report of Patra *et al.* [25] that Cd causes oxidative damage in the liver. The present study suggests that under certain doses of cadmium may alter liver functions.

Humphreys [31] also reported that hepatic damage caused when exposed to Cd is more toxic than to lead. Swiergosz-kowalewska [32] reported that Cd primarily accumulates in the liver which becomes more important target organ for damage. Cadmium serves no constructive purpose in the human body. It and its compounds are extremely toxic even in low concentrations [29]. The pathological effects of cadmium to organs and tissues, and the long-life in humans and animals, from 30 to 10 years, strongly indicate the need for control of the amount of cadmium in foodstuffs. For people cadmium is a carcinogenic and mutagenic element [33].

In conclusion, our present study provided evidences regarding the toxic and harmful effects of cadmium in the liver of mice.

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