



Study The Effects of Lead and Cadmium on The Kidney and Liver of Albino Rats



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Abstract

A HIGHLY harmful heavy metal known as lead (Pb) affects different organs' physiology and histology. Cadmium is a toxic element affecting some organs such as renal, and bones. This study aims to observe the microscopic tissue lesions of lead and cadmium in the liver and kidney. In this study, fifteen albino rats were divided into three groups. The first group is provided with oral normal saline, the second group is given a lead solution orally for three weeks at a dose of 17 mg/kg, and the third group is given a cadmium solution orally for three weeks at a dose of 15 mg/kg. The tissue sections are put directly in 10% neutral formalin solution to fix them for 24-48 hours and then cut into small pieces 1 cm³, then carried out the process of ascending alcohols and then in xylene, waxed in the form of molds and cut the pieces with a microtome on the thickness of (4-5) μm and then dyed with the routine stain hematoxylin and eosin. The findings included that the first group shows the normal architecture of the liver and kidney. The second group showed necrosis in the peripheral area due to the toxic effect of lead with fatty changes resulting from liver damage; the kidney showed proliferation of inflammatory cells (neutrophils), and mesangial cells in addition to the presence of coagulative nephritis. The third group showed liver fibrosis and inflammatory cells while the kidney showed mononuclear cells in chronic nephritis. We can conclude that lead and cadmium have negative and pathological changes in the kidney and liver tissue; these changes include accumulation of the inflammatory cells, congestion, and necrosis, in the liver, and kidney while showing nephritis in the kidney.

Keywords: Lead, Cadmium, Rats, Histopathology, Liver, Kidney.

Introduction

Food quality and safety is a public health issue of increasing importance, and consumers need to buy safe products without any health risks. Therefore, the growing demand for food safety is associated with eating foods that contain heavy metals [1]. The heavy metals like cadmium and lead are man-made pollution. The heavy metals accumulate inside the tissues of the organisms and lead to harmful effects, as they reach the cells and tissues of the body and bind to DNA, proteins, and leading to cellular destruction [2,3]. Lead is a pollutant that could threaten life in several ways. All lead-treated rats showed inclusion bodies inside the nuclear and kidney tubular. The lead causes a kidney enzyme

deficiency in rats [4]. Cadmium and lead are widespread pollutants in animals and humans. Tissue-specific changes included oxidative damage, accumulation of metals in tissues, negative changes in biochemicals, and hematological factors. Cd and Pb produce more histopathological changes in rats in humans and animals [5].

For this reason, the heavy metals have severe signs on the human and animal body, such as central nervous system, leading into mental disorders, and lung and liver damage [6]. Overcrowding of the people in small area, burning of toxic waste, the use of leaded gasoline, and industrialization, rapid growth in buildings increase the level the heavy

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metals in the wastes and the surrounding environment [7]. For this previous causes, this study aims to study of microbiological changes of lead and cadmium in the liver, kidney and lung in albino rats.

Materials and Method

Study design

Albino rat classified equally into three groups, each one consisting of five rats. The first group are administrated normal saline orally, and the second group is administrated lead solution orally 17 mg/kg for (21) days, and the third group is administrated cadmium solution orally 15mg/kg for (21) days.

The used materials

Lead solution (1000 ppm) and cadmium solution (1000 ppm) made by BDH company, England. distal water (Iraq). Ketamine (dutchfarm, Holand) and xylazine (VMD, Belgium).

The histological sections

The kidney and liver samples were put directly in 10% neutral formalin solution to fix them for 24-48 hours and then cut into small pieces 1 cm³, then carried out the process of ascending alcohols and then in xylene, waxed in the form of molds and cut the pieces with a microtome on the thickness of (4-5) µm and then dyed with the routine stain hematoxylin and eosin [8].

Results

The first group shows the normal architecture of the liver and kidney wherever, whereas the liver tissues showed normal histological structure which consists central vein or portal area and thread-like arrangement of hepatocyte cells as shown in Fig. (1).

The first group showed normal looking of the sections of the renal tissues with renal glomeruli and renal tubules as shown in Fig. (2).

The second group (G2) shows necrosis in the peripheral area due to the toxic effect of lead with fatty changes resulting from liver damage when treated for three weeks with lead orally as shown in Fig. (3), the kidney shows proliferation of inflammatory cells (neutrophils), mesangial cells in addition to the presence of coagulative nephritis when administration of lead solution for three weeks orally as shown in Fig. (4).

The current study includes the third group (G3) that used cadmium orally for three weeks and showed liver fibrosis, and inflammatory cells as shown in Fig. (5) while the kidney showed mononuclear cells in refer to chronic nephritis when

administrated cadmium for three weeks orally as shown in Fig. (6).

Discussion

The first group shows the normal architecture of the liver and kidney. G2 shows necrosis in the peripheral area due to the toxic effect of lead with fatty changes resulting from liver damage, the renal tissues showed the proliferation of neutrophils, mesangial cells, and coagulative nephritis. G3 showed liver fibrosis, and inflammatory cells, while the renal tissues showed mononuclear cells and chronic nephritis.

A study showed that renal tissue shows hemorrhage and blood vessel congestion due to lead accumulation [9]. Administration of lead orally leads to histopathological effects on the renal tissues [10]. Increase in the thickness of the basement membrane due to damage with vacuoles [11].

In this study, the male rats were treated with Pb, the histological sections demonstrated changes in the liver tissue such as congestion, necrosis, central vein dilation, liver vacuolation, inflammatory cell infiltration, and hyperplasia [12].

Lead is toxic for all organs and has significant negative effects on the kidney, CNS, and liver. A significant increase in liver enzymes SGPT and SGOT was observed due to lead toxicity. The lead acetate can induce changes in the hepatic architecture compared to the control group with vacuolated granular cytoplasm and mononuclear cellular infiltration [13].

Chronic exposure to lead causes changes in the liver (sinusoids and portal triads). The changes included nuclear vesiculation, anisokaryosis, cytoplasmic inclusions, hydropic degeneration, necrosis, and glycogen reduction. Furthermore, the portal triads have chronic inflammation, hemosiderosis, hyper of the kuffer cells, and fatty change [14].

The broilers fed with CdCl₂ showed abnormal tissues, irregular hepatocytes, hemorrhage, in the broiler liver, and decreased levels of some enzymes such as GSH and increased MDA levels [15].

Conclusion

We can conclude that lead and cadmium have negative and pathological changes in the kidney and liver tissue; these changes are included accumulation of the inflammatory cells, congestion, and necrosis, in the liver, and kidney while showing nephritis in the kidney.

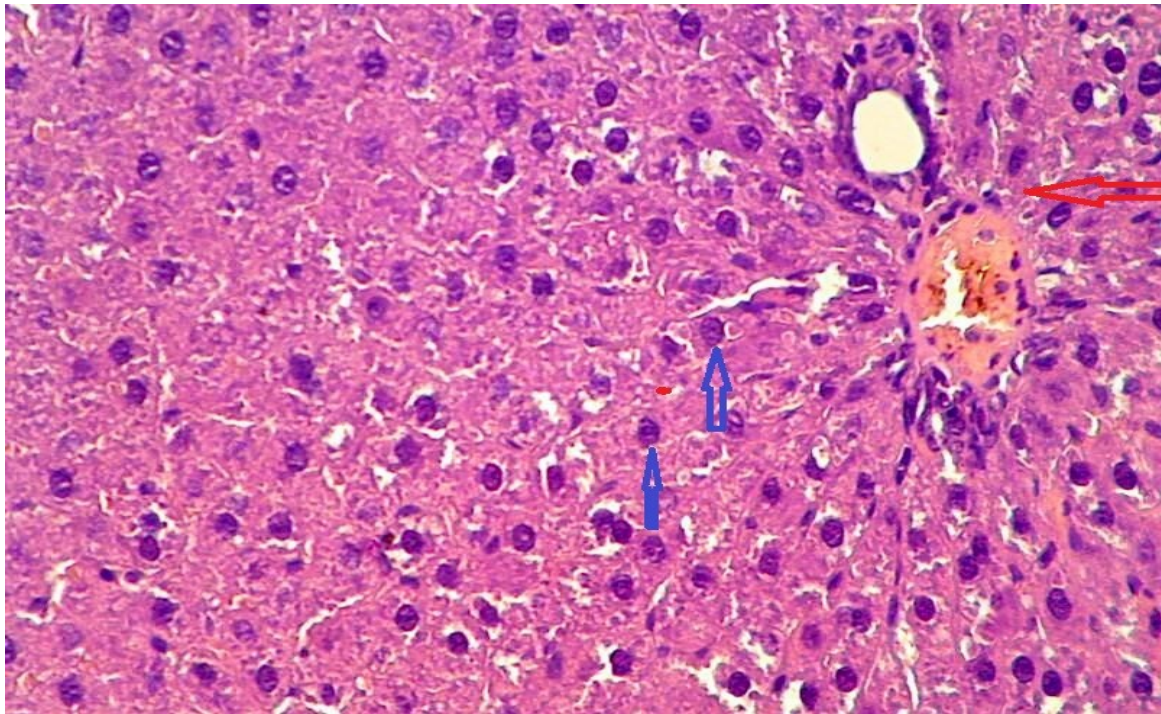


Fig. 1. The liver tissues showed normal histological structure which consists central vein or portal area (red arrow) and thread-like arrangement of hepatocyte cells (blue arrow) (X40) (H & E) in (G1).



Fig. 2. Section of the kidney showing the normal-looking appearance of renal glomeruli and renal tubules (Proximal and distal convoluted tubules. (X40) (H & E) in the control group (G1).

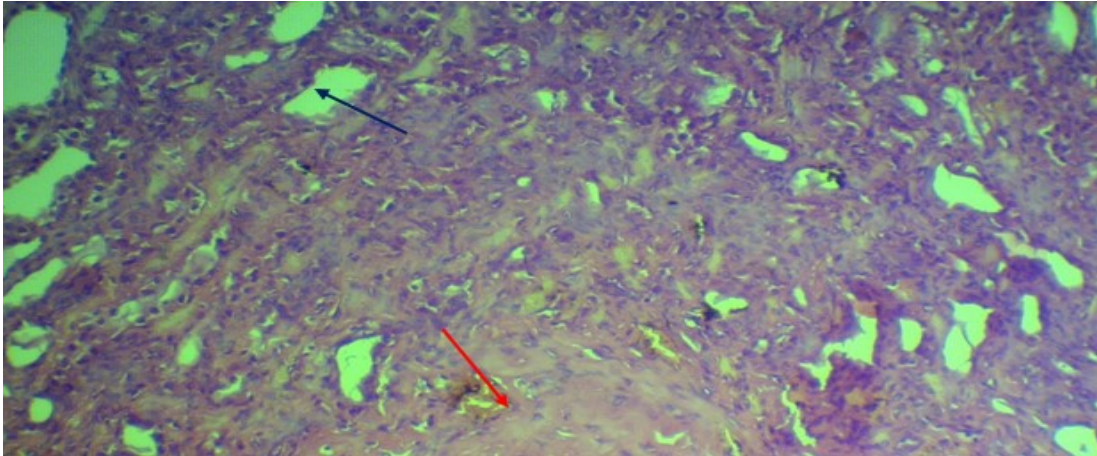


Fig. 3. Histological changes are dead necrotic area (red arrow) with the fatty vacuoles ((blue arrow)). (H&E stain 40X) in the group that administrated the lead for three weeks (G2).

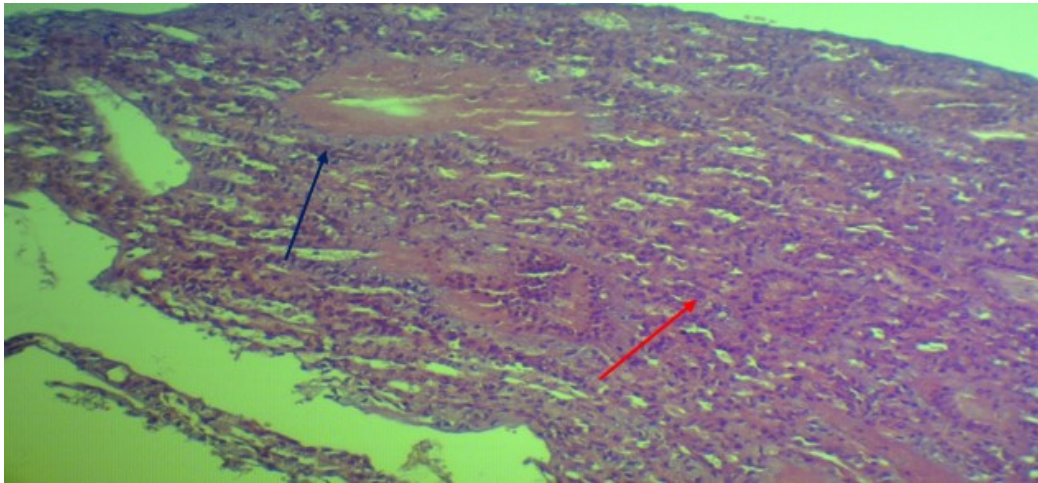


Fig. 4. Histological changes of the kidney are proliferation of neutrophils, mononuclear cells (lymphocyte and mesangial cells) (blue arrow), with coagulation (red arrow), (coagulative nephritis) (H&E stain 40X) in the group that administrated the lead three weeks (G2).

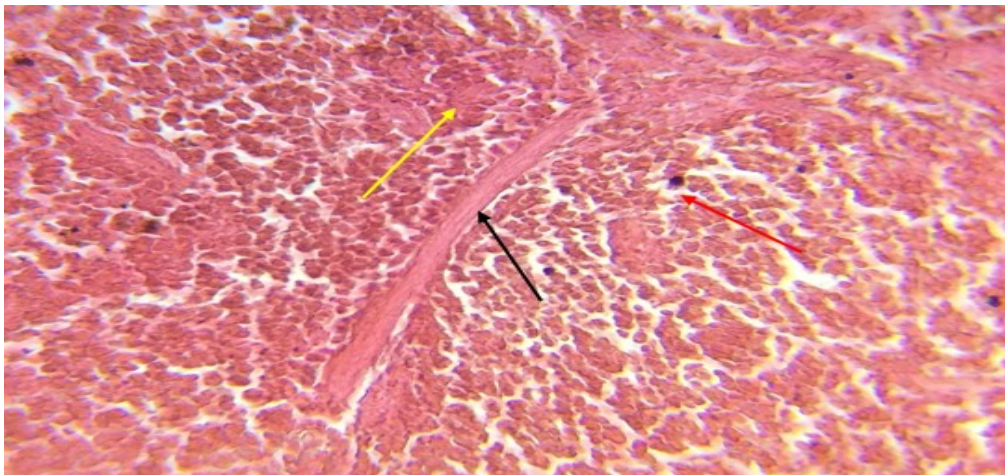


Fig. 5. shows the histopathological appearance of the liver, liver fibrosis (Black arrow), and collection of polymorphonuclear cells especially neutrophils (yellow arrow) and a few macrophages (red arrow). These refer to chronic hepatitis. (H&E stain 40X) in the group that administrated the cadmium for three weeks (G3).

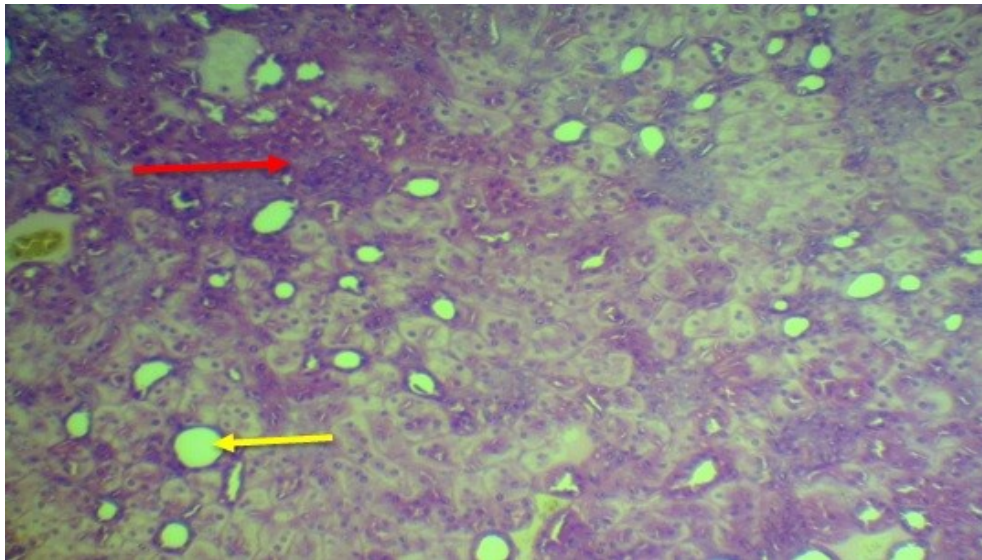


Fig. 6. Histological changes of the kidney are focal intertubular MNCs Infiltration (red arrow) and vacuoles (yellow arrow) (H&E stain 40X) in the group that administrated the cadmium three weeks (G3).

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دراسة تأثير الرصاص والكاديوم على الكلى والكبد في الجرذان البيضاء

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المستخلص:

الرصاص هو معدن ثقيل شديد الضرر يعرف (pb) يؤثر على فسيولوجيا وأنسجة الأعضاء المختلفة، وهو عنصر سام يؤثر على بعض الأعضاء مثل الكلى والعظام. الهدف من دراستنا هو ملاحظة أفة الأنسجة المجهرية للرصاص والكاديوم على الكبد والكلى. في هذه الدراسة، تم تقسيم خمسة عشر جرذاً إلى ثلاث مجموعات. تعطى المجموعة الأولى بمحلول ملحي طبيعي عن طريق الفم، وتعطى المجموعة الثانية محلول الرصاص فموياً لمدة ثلاثة أسابيع بجرعة 17 ملغم/كغم، وتعطى المجموعة الثالثة محلول الكاديوم فموياً لمدة ثلاثة أسابيع بجرعة 15 ملغم/كغم. توضع قطع الأنسجة مباشرة في محلول الفورمالين المتعادل 10% لتثبيتها لمدة 24-48 ساعة ثم تقطع إلى قطع صغيرة 1سم³ ثم تتم عملية كحولات تصاعديّة ثم في الزيلين مشمع على شكل قوالب وتقطع ثم تصبغ القطع بميكروتوم بسمك (4-5) ميكرومتر ومن ثم صبغها بالصبغة الروتينية الهيماتوكسيلين والأبوسين. وتضمنت النتائج أن المجموعة الأولى أظهرت بنية طبيعية للكبد والكلى. أما المجموعة الثانية فقد أظهرت نخرًا في المنطقة الطرفية نتيجة التأثير السام للرصاص مع تغيرات دهنية ناتجة عن تلف الكبد. أظهرت الكلى تكاثر الخلايا الالتهابية (العدلات) والخلايا اللممية بالإضافة إلى وجود التهاب الكلى التخرشي. المجموعة الثالثة أظهرت تلف الكبد وخلايا التهابية بينما أظهرت الكلى خلايا وحيدة النواة في التهاب الكلى المزمن. ويمكننا أن نستنتج أن الرصاص والكاديوم لهما تغيرات سلبية ومرضية في أنسجة الكلى والكبد؛ وتشمل هذه التغيرات تراكم الخلايا الالتهابية والاحتقان والنخر في الكبد والكلى مع ظهور التهاب الكلى في الكلى.

الكلمات الدالة: الرصاص، الكاديوم، الفئران، التشريخ المرضي، الكبد، الكلى.