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CLINICOPATHOLOGICAL EVALUATION OF KIDNEY FUNCTIONS AFTER CADMIUM CHLORIDE ADMINISTRATION IN MALE RATS.

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A B S T R A C T

The present study was conducted on male albino rats to evaluate the effects of renal toxicity induced by cadmium chloride ($CdCl_2$) on hematological, some biochemical blood parameters as well as the associated histopathological effects on kidney and liver. Ninety male rats were randomly divided into three equal groups (each group contained 30 rats) as follow: group A (control), group B (1 mg $CdCl_2$/kg, S/C), group C (2 mg $CdCl_2$/kg, S/C). Cadmium chloride injection to male rats leads to significant increases in creatinine, urea, uric acid and cystatin C indicating kidney damage. Potassium and inorganic phosphorus showed significant increases in cadmium treated groups, while calcium and sodium revealed significant decreases. Hypoproteinemia, hypoalbuminemia and elevation of cholesterol, trigrlycerides and LDL-cholesterol levels were observed in cadmium-treated groups. Liver enzymes activities including alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP) showed significantly increased indicating liver damage. Hematological parameters revealed significant decreases in red blood cells (RBCs), hemoglobin concentration (Hb) and hematocrit values (HCT) inducing anemia. Cadmium-treated groups showed leukocytosis, lymphocytosis and monocytosis indicating activation of the animal's immune system due to renal and hepatic toxicity by cadmium chloride. Platelets count showed a significant increase indicating reactive thrombocytosis induced by renal toxicity. Histopathological picture of the kidneys in cadmium-treated groups showed vacuolization in the lining endothelium of glomeruli with focal fibrosis in between atrophied tubules and glomeruli. Liver showed diffuse kupffer cells proliferation in the hepatic parenchyma and hyperplasia and cystic dilatation in the bile duct. From the obtained results, we could conclude that renal toxicity induced by $CdCl_2$ causes reduction in serum albumin concentration and oncotic pressure. Reduction in plasma oncotic pressure stimulates the hyperlipidemic response. So, renal damage is accompanied by hypoproteinemia and hyperlipidemia.

KEY WORDS: Cadmium chloride, Kidney, Liver, Lipid profile

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1. I N T R O D U C T I O N

Kidneys are vital organs play important roles in excretion of waste products and exchange of materials. Their function is essential to maintain the size and composition of body fluids within normal limits. Renal disease is defined as the occurrence of morphologic or biochemical renal lesions followed by consequence of biochemical changes as rise in blood urea nitrogen, creatinine, acute depletion of water and electrolytes, metabolic acidosis, hyperkalemia as well as hyper-phosphatemia that led to abnormalities in the body fluids associated with chronic hepatic failure [11]. Nephrotoxicity can be induced by chemical (toxicants) or biologic products (toxins) that are inhaled, ingested or absorbed through the skin [12]. Cadmium is one of the most toxic substances in the environment. With chronic exposure, cadmium accumulates in

the epithelial cells of the proximal tubule of the kidney and glomerulus which is believed to be irreversible at advanced stages [2]. Hyperlipidemia and hypoproteinemia are hallmarks of the nephrotic syndrome which results from altered glomerular permeability leading to urinary loss of macromolecules. As a consequence, serum albumin concentration and oncotic pressure are reduced [7]. Therefore, the present experiment was designed to study the effects of renal toxicity induced experimentally by using cadmium chloride on hematological and some biochemical parameters. Also, histopathological study on kidney and liver was performed.

2. MATERIALS AND METHODS

2.1. *Expermintal animals:*
The experiment was performed on ninety male albino rats (150-200 gram body weight). The animals were housed in metallic cages under suitable lighting (12 hour light), temperature and proper hygienic condition. Well-balanced ration and drinking water were available ad libitum. The animals were observed for 7 days before the experimentation.

2.2. *Chemicals:*
Cadmium chloride hydrated ($CdCl_2$, $2.5H_2O$, Mol.Wt. 228.35) obtained from Samir.Tech-chem PVT.LTD. Cadmium chloride was dissolved in saline at 2 doses (1mg/kg b.w and 2 mg/kg b.w) according to Yamano (1993) [39].

2.3. *Experimental design:*
The current work was conducted on ninety male laboratory rats. Rats were divided into three groups: group (A) in which 30 rats served as a control, group (B) in which 30 rats injected 1 mg $CdCl_2$/kg body weight (S/C) daily and group (C) in which 30 rats injected 2 mg $CdCl_2$/kg body weight (S/C) daily. The animals were sacrificed at 2, 4 and 6 weeks from injection of cadmium chloride.

2.4. *Blood samples*
Blood samples were collected by heart puncture from 10 rats of each groups at the 2^{nd}, 4^{th} and 6^{th} week of cadmium chloride injection and divided as follow:

*Whole blood***:** Blood was collected in clean dry bottle containing dipotassium salt of EDTA as anticoagulant at concentration of 2mg/1ml of blood and used for hematological studies.

*Serum***:** blood was collected in plain clean well-dried centrifuge tube and used for separation of serum to be used in estimation of biochemical parameters.

2.5. Tissue samples
Specimens from kidney and liver were collected from all groups after sacrificing and preserved in formalin (10%) for histopathological examination.

2.6. *Hematological examination*:
Hematological studies included erythrogram, luekogram and platelets counts. The erythrogram included erythrocytic count, hemoglobin concentration, packed cell volume (PCV) and red blood cell indices. The luekogram included total leukocytic count (TLC) and differential leukocytic count (DLC). Hematological studies were measured on hematology analyzer CLINDIAG HA-VET (Bulgaria).

2.7. *Biochemical parameters*:
Biochemical studies included creatinine, urea, uric acid, calcium, inorganic phosphorus, sodium, potassium total protein, albumin, cholesterol, triglyceride, HDL- cholesterol, ALT, AST and ALP were measured by using commercail diagnostic kits. Biochemical parameters were meaured on Cobas Integra (version 400, ROCHE DIGNOSTICS LTD, Germany). Determination of cystatin C in rat samples assayed by a double antibody sandwich enzyme linked immunosorbent assay (ELISA) (ELX50, Bioteck, USA).

2.8. *Histopathological studies:*
Samples were taken from the kidney and liver of rats in different groups and fixed in 10% formol saline for 24 hour. Specimens were cleared in xylene and embedded in paraffin. The obtained tissue sections deparaffinized and stained by hematoxylin and eosin stains for histopathological examination through the electric light microscope [4].

2.9. *Statistical analysis*
The obtained data was compared across groups using analysis of variance (ANOVA). Data was expressed as mean (±S.E.). differences between individual groups were estimated by least- significant difference (LSD) test *(P<0.05).*

3. RESULTS

3.1. *Biochemical results:*
Result of kidney function parameters (table 1) showed that there was significant increase in serum creatinine, urea, uric acid and cystatin C in $CdCL_2$ treated groups comparing with control group at all weeks of injection.
The obtained data (table 2) showed significant decrease of serum calcium and sodium levels in $CdCL_2$ treated groups at 4 and 6 weeks of injection while potassium and inorganic phosphorus showed significant increase at 2 weeks till the end of experiment period.
Results of total proteins and albumin (table 4) showed significant decrease in $CdCL_2$ treated groups at all weeks of injection compared with control group.
Lipid profile data (table 3) showed significant increase of cholesterol, triglycerides and LDL levels in Cd treated groups at 2 weeks till the end of experiment period while HDL-cholesterol levels showed significant decrease at 4 and 6 weeks of $CdCl_2$.
Results of liver transaminases (table 4) showed significant elevation of ALT, AST and ALP comparing with control group at all weeks of $CdCl_2$ injection.

3.2. *Hematological results:*
The obtained data (table 5) showed a significant decrease in red blood cells, hemoglobin concentration and hematocrit values comparing with control group from 2 weeks till the end of experimental period.
The data of leukocytic count (table 6) showed significant increase in $CdCL_2$ treated groups from 2 weeks till the end of experimental period.
Lymphocytic count showed a significant increase at 2, 4 and 6 weeks of injection.
Monocytic count showed significant increase at 4 and 6 weeks of injection.
Granulocytes (Neutrophils, eosinophils and basophils) showed significant increase at 6 weeks in Cd-treated groups when compared with control group.
Platelets count (table 6) showed a significant increase in $CdCL_2$-treated groups compared with control group from 2 weeks till the end of experimental period.

Table 1 Serum kidney function parameters in different groups

Group	Check time	Creatinine (mg/dl)	Urea (mg/dl)	Uric Acid (mg/dl)	Cystatin C (mg/dl)
Control	2w	0.44 ± 0.02^{a}	12.63 ± 0.32^{a}	1.33 ± 0.11^{a}	0.65 ± 0.04^{a}
	4w	0.52 ± 0.03^{a}	12.69 ± 0.40^{a}	1.81 ± 0.06^{a}	0.90 ± 0.04^{a}
	6w	0.51 ± 0.03^{a}	12.84 ± 0.43^{a}	1.93 ± 0.04^{a}	0.97 ± 0.02^{a}
I mg $CdCl_2$	2w	0.78 ± 0.03^{b}	17.38 ± 0.50^{b}	1.72 ± 0.03^{b}	1.04 ± 0.10^{b}
	4w	1.08 ± 0.04^{b}	19.68 ± 0.84^{b}	2.14 ± 0.10^{b}	1.37 ± 0.17^{b}
	6w	1.46 ± 0.08^{b}	20.28 ± 0.92^{b}	3.54 ± 0.18^{b}	2.13 ± 0.26^{b}
2 mg $CdCl_2$	2w	0.99 ± 0.04^{c}	18.75 ± 0.65^{c}	2.54 ± 0.28^{c}	1.37 ± 0.08^{c}
	4w	1.18 ± 0.05^{c}	22.01 ± 0.76^{c}	3.24 ± 0.30^{c}	1.93 ± 0.10^{c}
	6w	1.75 ± 0.06^{c}	23.69 ± 0.62^{c}	4.81 ± 0.15^{c}	3.45 ± 0.13^{c}

Means (± S.E) with different superscript (a,b,c) within the same column are significantly different at $p<0.05$.

3.3. *Histo-pathological results:*

Kidney of $CdCL_2$-treated groups showed vacuolization in the lining endothelium of glomeruli and congestion in cortical blood vessels with focal fibrosis in between atrophied tubules and glomeruli in kidney of cadmium treated rats. Moreover, hyperplasia with polyps formation in epithelial cells lining of the tubules and eosinophilic casts formation in the cystic tubular lumen was detected (fig1, 2, 3 & 4).

Liver of $CdCL_2$ treated groups showed dilatation and congestion in the central vein associated with focal inflammatory cells aggregation as well as diffuse inflammatory cells infiltration with diffuse kupffer cells proliferation in the hepatic parenchyma. The portal area showed hyperplasia and cystic dilatation in the bile duct, inflammatory cells infiltration and fibroblastic cells proliferation (fig5&6).

Table 2 Serum electrolytes and minerals in different groups

Group	Time	Sodium (mmol/L)	Potassium (mmol/L)	Calcium (mg/dl)	In. Phosphorus (mg/dl)
Control	2w	142.0±0.46^b	6.35±0.22^a	10.4±0.18^c	11.60±0.45^a
	4w	142.24±0.37^c	6.81±0.22^a	10.36±0.22^c	11.21±0.38^a
	6w	140.91±0.48^b	6.39±0.27^a	10.33±0.26^c	11.55±0.43^a
I mg $CdCl_2$	2w	140.75±1.42^b	10.30±0.42^b	9.76±0.19^b	13.58±0.31^b
	4w	139.03±1.26^b	10.85±0.41^b	8.35±0.26^b	13.23±0.28^b
	6w	138.50±2.57^a	10.90±0.36^b	6.51±0.27^b	14.28±0.18^b
2 mg $CdCl_2$	2w	137.75±0.94^a	10.75±0.46^b	8.43±0.25^a	14.43±0.28^c
	4w	136.58±1.95^a	12.69±0.68^c	7.17±0.11^a	17.06±0.78^c
	6w	138.45±0.95^a	12.81±0.29^c	5.44±0.30^a	18.4±0.26^c

Means (± S.E) with different superscript (a,b,c) within the same column are significantly different at $p<0.05$.

Table 3 Lipogram in different groups

Group	Time	Cholesterol (mg/dl)	Triglyceride (mg/dl)	HDL-chol (mg/dl)	LDL-chol (mg/dl)
Control	2w	62.13±0.83^a	66.88±2.68^a	29.13±1.19^a	50.30±2.79^a
	4w	64.13±2.05^a	67.88±3.14^a	28.13±1.20^a	52.58±2.74^a
	6w	63.00±1.71^a	64.00±2.02^a	32.13±1.26^b	44.48±1.67^a
I mg CdCl2	2w	79.25±1.06^b	104.13±2.87^b	29.00±1.68^a	91.48±3.75^b
	4w	95.38±3.09^b	115.75±2.63^b	27.75±1.61^a	111.33±4.94^b
	6w	99.25±2.10^b	113.38±2.71^b	26.88±1.14^a	117.35±9.43^b
2 mg CdCl2	2w	87.00±3.51^c	116.88±2.56^c	28.50±2.16^a	105.15±3.14^c
	4w	109.75±2.90^c	147.50±5.20^c	27.00±1.60^a	141.7±5.08^c
	6w	116.25±2.54^c	164.13±1.88^c	26.13±1.41^a	160.5±2.08^c

Means (± S.E) with different superscript (a,b,c) within the same column are significantly different at $p<0.05$.

Table 4 Total protein, albumin and liver transaminases in different groups

Group	Time	ALT (U/L)	AST (U/L)	ALP (U/L)	T.protein (g/dl)	Albumin (g/dl)
Control	2w	66.88±1.98^a	73.63±3.25^a	208.50±4.76^a	6.45±0.17^c	3.70±0.05^b
	4w	71.50±4.28^a	65.88±2.32^a	185.75±5.56^a	6.95±0.15^c	3.96±0.09^c
	6w	63.13±2.36^a	66.63±1.81^a	199.75±6.01^a	7.36±0.17^c	3.78±0.1^b
I mg $CdCl_2$	2w	93.75±2.86^b	88.75±2.33^b	279.38±10.70^b	5.68±0.05^b	2.46±0.12^a
	4w	111.15±2.57^b	107.88±3.30^b	347.25±18.27^b	5.07±0.05^b	2.68±0.15^b
	6w	124.50±3.95^b	119.75±2.18^b	570.63±13.24^b	4.53±0.17^b	2.05±0.10^a
2 mg $CdCl_2$	2w	101.75±2.45^c	109.75±2.72^c	683.50±9.41^c	4.78±0.07^a	2.33±0.14^a
	4w	135.88±2.42^c	124.85±2.88^c	541.50±32.7^c	4.24±0.07^a	2.14±0.13^a
	6w	138.00±2.36^c	134.75±1.94^c	704.63±10.66^c	3.81±0.11^a	1.93±0.08^a

Means (± S.E) with different superscript (a,b,c) within the same column are significantly different at $p<0.05$.

Table 5 RBCs, Hb and red blood indices in different groups

Group	Time	RBCs ($\times10^{12}$ /L)	Hemoglobin (mg/dl)	Hematocrit (%)	MCV (fl)	MCHC (g/dl)
Control	2w	7.66±0.16^{c}	12.28±0.27^{c}	36.18±1.28^{b}	46.60±1.03^{a}	33.50±0.26^{a}
	4w	7.97±0.27^{c}	12.44±0.41^{c}	36.67±1.84^{c}	44.00±1.00^{a}	33.60±0.41^{a}
	6w	7.87±0.19^{c}	12.90±0.19^{c}	38.67±0.96^{c}	44.66±2.52^{a}	34.92±1.26^{b}
I mg $CdCl_2$	2w	6.95±0.05^{b}	11.34±0.20^{b}	35.52±0.78^{a}	50.20±0.92^{b}	32.16±0.63^{a}
	4w	6.58±0.14^{b}	9.72±0.25^{b}	34.26±0.96^{b}	45.40±1.12^{a}	32.76±0.66^{a}
	6w	5.22±0.07^{b}	7.04±0.26^{b}	22.89±1.35^{b}	46.60±0.75^{a}	33.40±0.38^{b}
2 mg $CdCl_2$	2w	6.41±0.14^{a}	10.76±0.11^{a}	33.83±0.37^{a}	52.20±1.16^{c}	32.00±0.58^{a}
	4w	6.13±0.14^{a}	8.54±0.16^{a}	27.36±0.98^{a}	49.00±1.10^{b}	31.54±0.73^{a}
	6w	4.11±0.17^{a}	5.46±0.31^{a}	19.55±1.69^{a}	46.74±2.14^{a}	31.28±2.00^{a}

Means (± S.E) with different superscript (a,b,c) within the same column are significantly different at $p<0.05$.

Table 6 Leukogram and platelets in different groups

Group	Time	WBCs ($\times10^{9}$/L)	Lymphocytes ($\times10^{9}$/L)	Granulocytes ($\times10^{9}$/L)	Monocytes ($\times10^{9}$/L)	Platelets ($\times10^{9}$/L)
Control	2w	1.54±0.32^{a}	1.50±0.15^{a}	0.03±0.01^{a}	0.06±0.01^{a}	586.6±39.43^{a}
	4w	2.42±0.18^{a}	2.31±0.17^{a}	0.04±0.01^{a}	0.09±0.01^{a}	678.8±22.15^{a}
	6w	2.98±0.11^{a}	2.85±0.09^{a}	0.04±0.01^{a}	0.09±0.01^{a}	790.0±18.76^{a}
I mg $CdCl_2$	2w	2.68±0.21^{b}	2.57±0.21^{b}	0.04±0.01^{a}	0.10±0.02^{ab}	1183.0±88.06^{b}
	4w	4.34±0.68^{b}	4.08±0.63^{b}	0.11±0.02^{a}	0.22±0.03^{b}	1203.2±77.01^{b}
	6w	11.86±0.57^{b}	10.77±0.58^{b}	0.36±0.07^{b}	0.70±0.05^{b}	1357.2±36.09^{b}
2 mg $CdCl_2$	2w	4.16±0.63^{c}	4.01±0.25^{c}	0.05±0.01^{a}	0.15±0.03^{b}	1552.8±48.81^{c}
	4w	8.44±0.47^{c}	7.63±0.32^{c}	0.33±0.09^{b}	0.54±0.09^{c}	1590.8±45.47^{c}
	6w	18.68±1.27^{c}	17.37±1.32^{c}	0.48±0.05^{c}	0.83±0.03^{c}	1776.8±111.64^{c}

Means (± S.E) with different superscript (a,b,c,d) within the same column are significantly different at $p<0.05$.

4. DISCUSSION

Concerning to the nephrotoxic effect of cadmium chloride, kidney functions including creatinine, urea, uric acid and cystatin C showed significant increase in Cd treated groups. These results agree with results obtained by Shibutani (2001) [31] and Uchida (2010) [36]. It has been suggested that cadmium chloride exerts direct toxic effect on the glomerulus [40] and induced tubular damage leads to interstitial nephritis which in turn results in decreased glomerular filtration rate (GFR) [10]. Regarding to the disturbance in electrolytes and minerals caused by renal toxicity by cadmium chloride, calcium showed significant decrease in Cd treated groups because cadmium chloride causes inhibition of renal conversion of 25-hydroxycholecalceferol to 1, 25-dihydroxycholcalceferol in rats [27]. Also, cadmium inhibits vitamin D-stimulated intestinal calcium transport in rats [28]. Hyperkalemia and hyperphosphatemia was observed in Cd treated groups due to severe reduction in glomrular filtration rate (GFR).

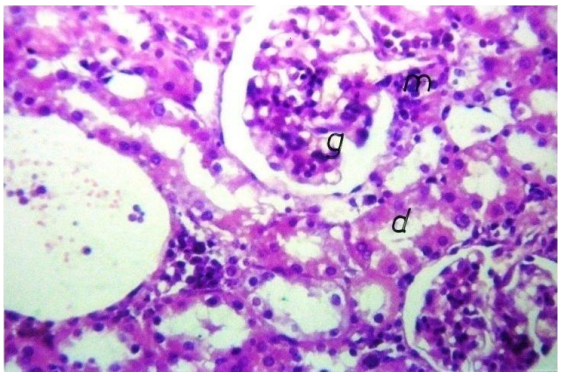

Fig (1): Kidney of rats administrated $CdCl_2$ showing vacuolization of the lining endothelium of the glomerular tuft (g), degeneration in the lining epithelial cells of the tubules (d), focal inflammatory cells infiltration (m) and tubular cystic dilatation (c).

Hyperphosphatemia in renal failure is observed usually after the onset of azotemia or loss of more than 75% of the nephron population which lead to decreasing renal excretion of phosphate [30]. Hyponatremia was observed in Cd treated groups as Preoteinuria in renal disease may lower plasma oncotic pressure and reduce effective arterial blood volume (EABV), triggering activation of the rennin-angiotensin and aldosterone system and ADH release in case of cadmium chloride toxicity. Hyponatraemia may also result from defective renal salt and water excretion [6]. These results also obtained by Abo-Salem (1991) [1]. Total proteins and albumin levels showed significant decrease in Cd treated groups. Hypoprotienemia and hypoalbuminemia also observed by El-Demerdash (2004) [9].

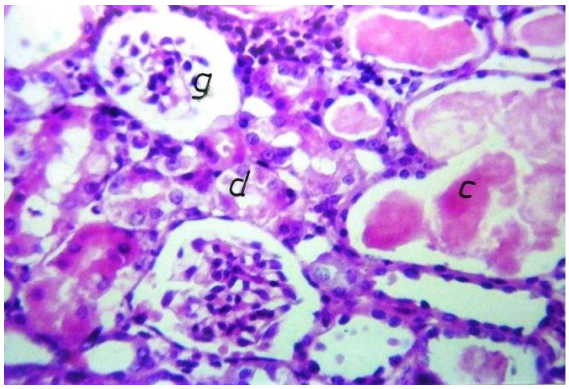

Fig 2 Kidney of rats administrated Cd Cl_2 showing degeneration in epithelial cell lining the tubules (d) , atrophy of the glomeruli (g) and renal cast in cystic tubules (c)

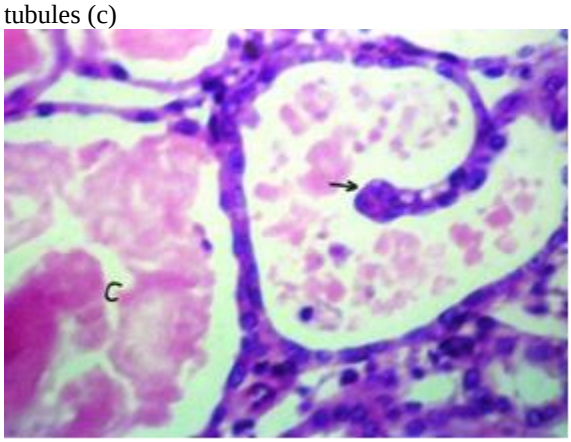

Fig 3 Kidney of rats administrated $CdCl_2$ showing epithelial cells hyperplasia in the tubules with polyps formation and cystic dilatation (arrow).

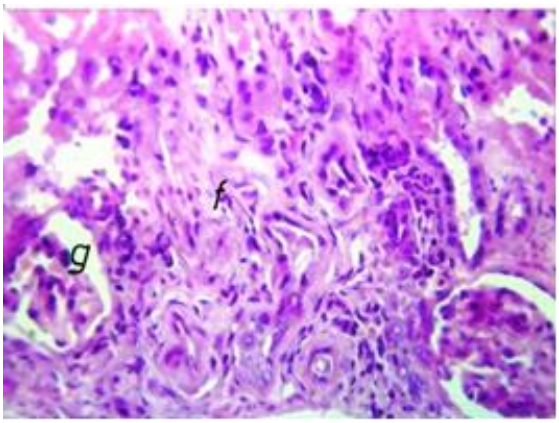

Fig 4 Kidney of rats administrated $CdCl_2$ showing renal cast in the lumen of cystic tubules (c) at corticomedullary junction.

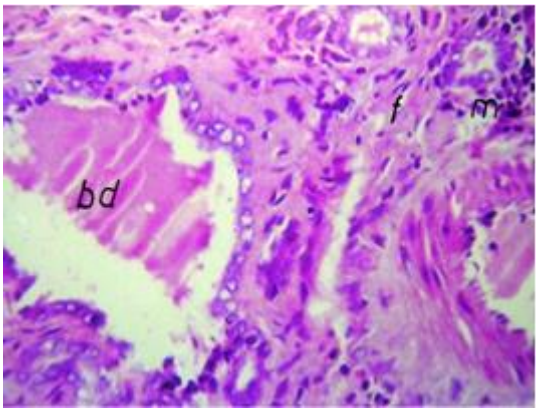

Fig (5): liver of rats administrated $CdCl_2$ showinghyperplasiaof bile duct with cystic dilatation (bd) and fibrosis (f) with inflammatory cells infiltration (m) in the portal area

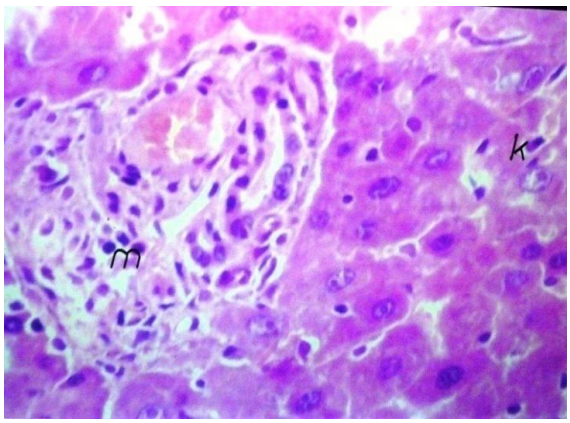

Fig (6): liver of rats administrated $CdCl_2$ showing focal inflammatory cells infiltration (m) with diffuse kupffer cells proliferation (k) in the hepatic parenchyma.

Hyperlipidemia and hypoproteinemia are hallmarks of the nephritic syndrome which results from altered glomerulari. Hypoprotienemia is believed to be a consequence of break down in the

permeability selective barrier of the glomerular capillary wall (comprised of the endothelial cell, glomerular basement membrane and the slit-pore diaphragm of the podocyte) [32]. Also, the observed hypoproteinemia may be attributed to the toxic effect of cadmium on liver [14]. Serum albumin was decreased mainly as a consequence of renal damage by cadmium. When the glomerulus is damaged, usually basement membrane permeability is increased and greater quantity of high molecular weight proteins like albumin (MW 69000) and transferrin (MW 76000) can pass into the glomerular filtrate [24].

Lipid profile including cholesterol, triglycerides and LDL-cholesterol levels in Cd treated groups showed significant increase. These results agree with Larregle (2008) [23] and Wang (2012) [37]. The two most common lipid abnormalities in the nephrotic syndrome are hypercholesterolemia,hypertriglyceridemia [38]. The hyperlipidemic response is triggered by the reduction in plasma oncotic pressure and severity of the hyperlipidemia is inversely related to the fall in oncotic pressure [17**].** In nephrotic syndrome, Low oncotic pressure directly stimulates hepatic apoprotein B gene transcription [40**].** Therefore, the rise in cholesterol levels is due to enhanced hepatic synthesis of lipoproteins containing apolipoprotein B and cholesterol [3].

Liver enzymes including ALT, AST and ALP showed significant increase. The obtained data agree with El-Demerdash (2004) [9]. Liver cells damage by $CdCl_2$ releases these enzymes into the extracellular fluid and results in increased plasma levels of transaminases activity [21].

Regarding to the hemogram, RBCs, hemoglobin concentration and hematocrit values showed significant decreases. These results are in agreement with El-Demerdash (2004) [9]. From results of MCV and MCHC, type of anemia in the present work is macrocytic hypochromic. Anemia induced by cadmium may be explained by several mechanisms including hemolysis due to deformity of peripheral red blood cells (RBCs) [22]. Cadmium enters the blood where it binds with the red blood cell (RBC) membranes [5]. In the blood, cadmium stimulates the formation of reactive oxygen species (ROS) thus causing oxidative damage in RBCs which result in loss of membrane functions [33]. The second mechanism is iron deficiency through competing with duodenal iron absorption [13]. The third mechanism is renal anemia derived from hypoproduction of erythropoietin [15]. an erythroid specific glycoprotein hormone produced from the kidneys that regulates the volume of RBCs [8].

Leukocytic count showed a significant increase in Cd-treated groups indicating activation of the animal's immune system due to renal and hepatic toxicity by cadmium chloride [9]. Leukocytosis also obtained by El-Demerdash (2010) [9] and Yamauchi (1992) [40]. Also, leukocytosis might be due to intoxications and tissue necrosis or due to the participation of neutrophils and monocytes in the process of phagocytosis as scavengers for wide variety of particulate material [26].

Regarding to platelets count, it showed significant increase in Cd treated groups. Thromocytosis by $CdCl_2$ also obtained by Kostić (1993) [20] and Rhman (2011) [29] Renal failure or nephrotic syndrome may cause reactive thrombocytosis [35]. Infection and inflammation cause overproduction of thrombopoietic factors that act on megakaryocytes or their precursors [25].Thrombopoietic factors include many cytokines such as interleukin-6 (IL-6) and interleukin-1 (IL-1) which promote megakaryocytopoiesis or production of platelets. Plasma levels of IL-6 are elevated in reactive thrombocytosis and up-regulates the expression of thrombopoietin messenger RNA (mRNA) in the liver [18]. Thrombopoietin (TPO) is the principal regulator of megakaryocytopoiesis and

called megakaryocyte growth and development factor [19]. Thus, interleukin-6 may be a key mediator of the increased synthesis of thrombopoietin and the consequent reactive thrombocytosis [16].

5. CONCLUSION

It is concluded that cadmium chloride has toxic effect on kidney. As a consequence, serum albumin concentration and oncotic pressure are reduced. Reduction in plasma oncotic pressure stimulates the hyperlipidemic response. So that hyperlipidemia and hypoproteinemia are hallmarks of kidney disease or damage.

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مجلة بنها للعلوم الطبية البيطرية
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دراسات باثولوجية اكلينيكية على وظائف الكلى بعد حقن مادة كلوريد الكادميوم

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الملخص العربى

أجريت الدراسة على فئران التجارب لدراسة تأثير مادة كلوريد الكادميوم على أنسجة الكلى ودراسة تأثير أمراض الكلى على مستويات البروتينات والدهون في الدم خلال 6 أسابيع. تم تقسيم 90 فأر تجارب إلى ثلاث مجموعات متساوية احتوت كل مجموعة علي 30 فأر على النحو الأتي: المجموعة الاولى (الضابطة) ، المجموعة الثانية التى تم حقنها بمادة كلوريد الكادميوم بمعدل 1 مجم لكل كيلو جرام من وزن الجسم تحت الجلد ، المجموعة الثالثة ويتم حقنها بمادة كلوريد الكادميوم بمعدل 2 مجم لكل كيلو جرام من وزن الجسم تحت الجلد واخذت العينات عند الأسبوع الثانى والرابع والسادس من الحقن . وأسفرت النتائج عن وجود زيادة معنوية في مستوي كلا من وظائف الكلى و الدهون الثلاثية والكولسترول الكلي و وانزيمات الكبد بينما أظهرت الفحوصات وجود نقص معنوى فى كلا من بروتين الدم الكلى والالبيومين. كما أظهرت النتائج وجود أنيميا مصحوبة بنقص معنوي في تركيز الهيموجلوبين وعدد خلايا الدم الحمراء وخلصت النتائج إلى أن مادة كلوريد الكادميوم لها تأثير سام على أنسجة الكلى يكون مصحوبا بخلل في وظائف الكلى و نقص مستوى البروتين الكلى والالبيومين والذي يؤدى بدوره إلى نقص في الضغط الاسموزي للدم. هذا الخلل في الضغط الاسموزى يؤدى إلي زيادة نسبة الدهون في الدم.

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