Evaluation of Renal Toxicity in Male Albino Rats Rattus *Rattus* After Silver Nanoparticles Exposure

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Abstract— **Silver nanoparticles could be accumulated within numerous organs of the body after oral exposure, especially livers and kidneys. The current project aims to evaluate renal toxic effects caused by silver nanoparticles. Fifteen 10 to 12-week old healthy adult male rats weighted [200-230] gm were used in the recent study; Rats were treated with solutions containing 30 mg/kg and 125mg/kg body weight of silver nanoparticles for 28 days. Body weights were measured. Blood was withdrawn for evaluation of blood urea nitrogen, creatinine and kidneys and histologically processed for exhibiting the histological changes. Results showed that body weights were not changed significantly, blood urea nitrogen and the creatinine in types of the Blood of treated rat groups compared with the control group. The histological inspection revealed degenerative changes at the glomerular level. It exhibited a loss or disintegration in the tubular architecture, with a partial damage of many kidney corpuscles, with losing the capillary tufts of the glomeruli in the treated groups. At the same time, histological observation of controls was observed save their intact architecture. The current project concluded silver nanoparticles are critical toxic affection on kidneys.**

Index Terms—**Histology, kidneys, rat, silver nanoparticles**

I. INTRODUCTION

This nanotechnology deals with small-sized particles with an average size of 100nm [1]. According to their origin, nanomaterials were classified into natural and synthetic nanomaterials designed or engineered by the European Commission[2]. In the last few decades, nanotechnology has spread in various fields such as medicine, therapeutic styles, drugs development, biotechnology, and the environment[2]. Various and different studies were established to evaluate and evaluate silver nanoparticles' effects because of their increasing usage in modern life. As they are small-sized, they could enter organism bodies through inhalation, ingestion, and skin contact[3]. The most effective mechanism of silver nanoparticles cytological toxicity was oxidative stress, resulting from the creation and formation of free radicals reactive oxygen species, like decreasing the superoxide dismutase activity, glutathione depletion, and increased peroxidation lipids[4]. The oxidative stress resulting from silver nanoparticles is not related to silver ion toxicity but related to nanoparticle effects[5]. Damage of the renal function results from and is caused by intrarenal cell apoptosis, which, if enhanced, could cause tubular atrophy and glomerulosclerosis—a characteristic sign of kidneys disorders which were resulted from toxins, for example[6].

The main aim of the in-progress study is to evaluate the extent of renal histological toxicity induced from silver nanoparticles after 28 days of oral administration.

II. MATERIALS AND METHODS

In controlled conditions in the animal house in Babylon university; of temperature, humidity, dark and light period for 12 hours of each with access water and diet ad libitum. Fifteen male healthy adults rats of *rattus rattus* weighted 200-230gm with ten to twelve weeks of age were included in the study. Animales were grouped randomly into three groups: the control was given distilled water; the second group rats were orally given 30mg/kg body weight of silver nanoparticles; the last group administered 125mg/kg body weight of silver nanoparticles [7]. At the end of the experiment, rats were sacrificed for gathering kidneys, Blood was withdrawn, and body weight was evaluated before and after the experiment. For histological investigations, kidneys were excluded and fixed with 10%formalin and then processed for examination of the light microscope. Results were exhibited as mean± the standard deviation, and they were statistically analyzed using student t-test or ANOVA.

II. RESULTS

The present study demonstrated [table 1] significant dose-related variations at body weight gain in the two treated animal groups compared with the control group. There are many ways for silver nanoparticles exposure, such as dermal contact, ingestion and inhalation[8]. The oral route occurs in many cases like industries, Food and medical products. Daily ingested amounts from silver mineral; was derivative from the natural resources; water and Food are approximately 0.5 to 30 µg[9]. Translating silver nanoparticles to the Blood would be followed by spreading through the different body organs, especially livers, kidneys, brains, spleens, and the lung[10]. The kidneys were one of the most susceptible body organs during the lengthy introduction to nano-mater or any other toxic mater [11], who explained that the orally given administration from silver nanoparticles for a period of 28 days to 90 days could cause its accumulation in the kidneys. The present study demonstrated [table 1] significant dose-related variations at body weight gain in treated animals, which agreed with[11,12]. Animal body weights were an indicator of the effects of toxicants, and many previous types of research were explained that the intravenous administration of silver nanoparticles

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caused a significant decrease in body weight in Wister rats[20,21,22]. The function of kidneys exhibited credits on the levels of blood urea nitrogen and creatinine in the blood serum. Nevertheless, those parameters were showed statistically non-significant variations among the silver nanoparticle exposure groups and the control group[Table 1].

Table 1: shows the body weight gain, serum blood urea nitrogen, level of creatinine of male albino rats after 28 days of orally given silver nanoparticles

Groups	Bodyweight gain /gm	Blood urea nitrogen mg/dl	Creatinine mg/dl
	Mean ±SD	Mean ±SD	Mean ±SD
Control	70.6±15.4	69.5±3.77	0.76±0.05
30mg/kg B.W. of Ag NPs	62.1±7.03	65.5±3.12	0.69±0.08
125mg/kg B.W.of AgNPs	75.6±17.30	59.4±1.50	0.68±0.04
L.S.D.	81.763	74.22	1.61

Histological results of kidneys[Figure 1] were showed a dose-dependent induction of silver nanoparticles lesions in the renal corpuscles, tubules, interstitium and inflammation. Microscopic evaluation exhibited damage in many renal corpuscles and shrank in the capillary tufts of the glomeruli, and those changes were further projected in the treated groups. Significant distortion of those capillaries was pronounced in toxic conditions and severe renal injury[14,15]. Results have exhibited vacuolization, pyknotic nuclei, and degenerative changes. Those toxic effects of toxic substances on vacuolar degeneration showed as effects of cisplatin and different types of nanoparticles[16,17]. Concerning the current observations, other researchers, through their use of different nanoparticles with different sizes, might result in congestion of the capillaries of the renal tubules with inflammatory cell infiltration[13,15].[18] was explained that the inflammatory infiltration of cells is a symbol of cellular atrophy of the tubular cells in the chronic diseases of the kidneys. Those inflammatory responses appear due to the oxidative stress caused by silver nanoparticles that contribute to vascular congestion[19],[20] were evaluated the oxidative stress of intraperitoneally exposed mice with silver nanoparticles.

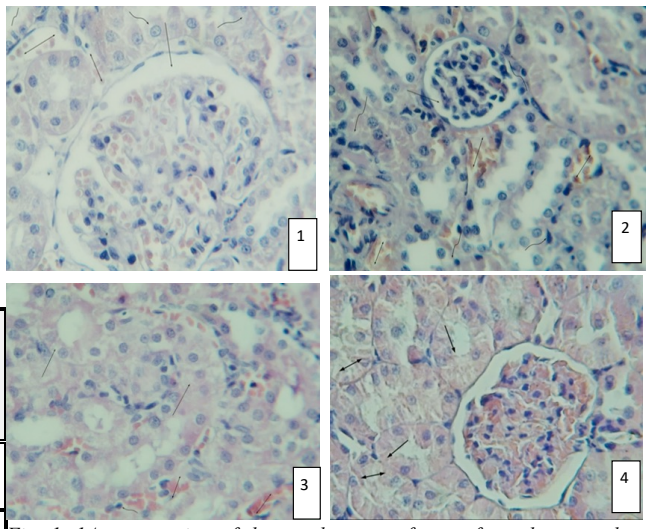

Fig. 1. 1Across-section of the renal cortex of a rat from the control group showed normal architecture of renal histology. 2. Blood vessel congestion with degenerative glomerular changes, glomerular fibrosis, and pyknotic nuclei. 3. Inflammatory cell infiltration and cell vacuolation. 4. Necrotic nuclei with capillary congestion.[40X, H AND E stain].

Blood urea nitrogen didn't increase significantly compared with controls; however, the kidneys observed an inflammatory response. A result gives an impression that these responses were very weak for making impairment in the kidney's filtration capacity, a result agreed with the results of [11,13]. Present results of blood urea nitrogen and creatinine were observed by [23], who obtained the same results after different doses intraperitoneal injection of mice for nine days. [24] There was a significant increase in blood urea nitrogen only with no difference in creatinine of treated groups compared with control after the subacute dermal exposure of silver nanoparticles in male mice. While[25] were presented a significant increase in both blood urea nitrogen and creatinine resulting from the administration intravenously of silver nanoparticles in rats.

CONCLUSION

The current study demonstrated that silver nanoparticles could induce renal toxicity, as proved through histomorphological changes. The study concluded that the occurrence and incidence of renal fibrosis is in concomitant with the progressive changes at the glomerular and tubular level due to silver nanoparticles exposure.

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