REVIEW ARTICLE

Investigation of the Effect of Calcium Oxide on Acute and Subchronic in Kidney and Testis of Wister Male Rats

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ABSTRACT

Aim of the study: The study was carried out to evaluate the modification of kidney and testis tissue of Wister male rats induced by calcium oxide nanoparticles (CaO-NP).

Background: The fifth chemical element on the crust of the earth is calcium. It is noted that calcium is the essential mineral for all organisms because it plays an important role in the human cells functions, and it is the effect on binding the bone and teeth by producing calcium phosphate. On the other hand, the low level of calcium element in the body leads to weakness, dental caries, and muscle cramps.

Methods: The animals were divided into two groups according to CaO treatment. The first group received single normal saline and was considered a control group; the second group received 100 mg\kg CaO-NP orally of bodyweight-only for 10 days on a row. Rats were sacrificed the10thday of treatment, and tissues were obtained for histological evaluation included kidney and testis.

Results: Many modifications were observed in kidney tissues, including necrosis of mesangial cells and podocytes with infiltration of inflammatory cells and hemorrhage. Additionally, testis tissues showed necrosis of spermatogonia, spermatocytes, and spermatids.

Conclusion: Calcium Oxide Nano Particles decreased number of spermatozoon in seminiferous tubules adult male Wister rats.

Keywords: Calcium oxide nanoparticles, Kidney, Nanoparticles, Rats, Testis.

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Conflict of interest: None

INTRODUCTION

The recent reports have paid all their attention to toxicity assessment of nanoparticles prior to clinical and biological applications. *In vitro* studies have been expanded constantly. Nevertheless, a unified system has not been established *in vivo* studies of nanoparticles yet. Predictive models and validated standards are considered as imperative methods. This paper will summarize the current progress in approaches that assess nanotoxicity in main systems, including the renal and hepatic, gastrointestinal, pulmonary, nervous, cardiovascular, and immune systems. The amount of literature published on histopathological studies and specific functional examinations is considerable. Additionally, these studies are illustrated, and related injury mechanisms are discussed.[1]

Multiple terms are used to describe nanotechnology. The most common are those regarding understanding and controlling of matter at dimensions of roughly 1–100 nanometers, which advances cellular uptake efficiencies and donates unique physical properties that are potentially acceptable in biomedical research.[2,3] Nanotechnology was applied in various and major fields, for example, medical agriculture, industrial and manufacturing segments.[4,5]

It is worth mentioning that the nanoparticles was observed resolute, mainly for nanomaterials that can be partially toxicity and toxic mechanisms,[6,7] Calcium Oxide – Nanoparticles (CaO-NPs) might lead to renal toxicity.[8] Thus, the present paper aims to investigate the toxic effects of CaO-NPs (<100nm) on perfect through repeated oral administration of adult male Wister rats.

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MATERIAL AND METHODS

Materials

Calcium oxide Nanopowder was purchased from the Iraqi Nanomaterials Pioneers Company (Najaf, Iraq). CaO is characterized by crystallization, and the crystal size was measured using Scherrer equation. Ithas been found that the average crystallite size (D) of synthesized Calcium Oxide NanoParticles was 46 nm 2-D and 3-D AFM images of the synthesized Calcium Oxide.

The three different crystal phases; CaO, $CaCO_3$, and Ca(OH) as illustrated in Figure 2.1.

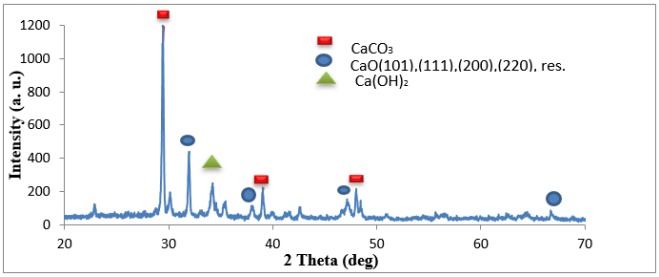

Figure 2.1: XRD pattern of synthesized CaO-NPs

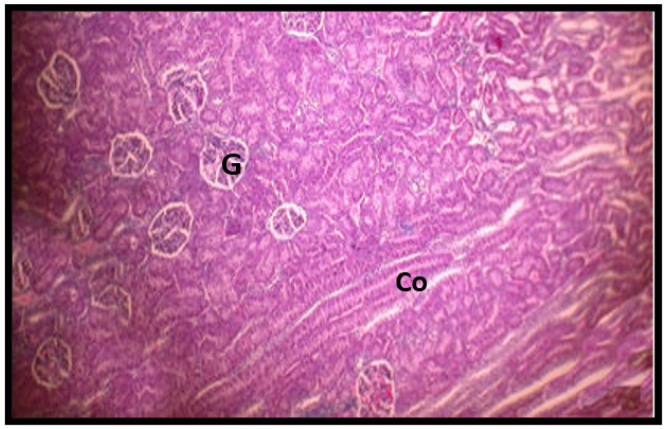

Figure 3 a: Tissue section of l kidney from control rabbit (cortex region) contain glomerular (arrow, G) with collecting duct(arrow ,Co), (H & E, X100).

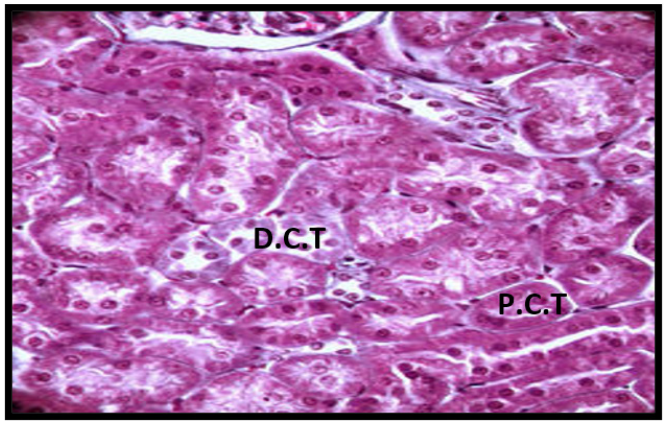

Figure 3 b: Tissue section of l kidney from control rat, (cortex region) contain proximal convoluted tubules (arrow ,P.C.T) and distal convoluted tubules (arrow, D.C.T),(H & E, X400).

The Formulation of Nanoparticle Suspension

The suspension was prepared by the resuspending CaO-nanoparticles in the bi- distilled water a stock solution.

Animals

The experimental plan were performed using 6 male waster albino rats weighing (150–340 g). Animals were obtained from the University of Karbala and housed in clean cages in the Science Faculty laboratory. The animals were maintained under straight laboratory conditions, including optimal temperature, humidity, and light: dark cycle (13 hours light/ 11 hours dark cycle). Distilled water and commercial food bits for rats were available.

After one week of acclimation, the suspension of CaO-NPs dosage daily for male rats for ten days. Animals were randomly divided into two groups; each group was contained three rats (n = 3). Control group animals were treated with 0.9% normal saline only, while the experimental groups were treated with 100 mg/kg CaO-NPs suspension orally through an intragastric oral intubation tube for 10 serial days. On the 11th day, all animals were weighed, sacrificed on 10th day of treatment, and all tissues were obtained from a histological evaluation that included kidney and testis tissues. All tissues were placed in 10% buffered formalin, then embedded in paraffin and stained with hematoxylin and eosin.[8]

RESULTS AND DISCUSSIONS

The control and experimental groups are detected by Histopathological examination. It investigated that the control group showed normal section tissues for the kidney (Figure 3 (a-d). In contrast, treated group with CaO-NPs Glomerulonephritis was observed lesion. Necrosis of mesangial cells and podocytes with infiltration of inflammatory cells (white arrows) and hemorrhage (black arrows) were observed and these observations lead to the loss of normal architecture of glomerulus. Glomerulus capillaries sclerosis (arrowheads) also observed (Figure 4 a and b). Glomerular diseases are related with immunological agents and toxins.[9] Similar severe tubular hemorrhage represented with arrows, CaO NPs toxicity, were observed in renal tubular necrosis and tubular parenchymatous degeneration by using hematoxylin and eosin protocols. It was noted that severe tubular degenerations were observed in kidney tissues.[10]

Tissues sections from animals that received CaO-NP showed necrosis of spermatogonia, spermatocytes, and spermatids, whereas seminiferous tubules' lumen appeared fully empty (black arrows). Enlargement of inter seminiferous tubules spaces with infiltration of edematous fluid (white arrows) with absence of Leydig cells were detected. Additionally, the debris of necrotic cells was observed in seminiferous tubules lumen (black arrows), empty seminiferous tubules lumen due to necrosis of male germs cells, and Sertoli cells also observed. Enlargement of inter seminiferous tubules spaces (yellow arrows) with Leydig cells' absence was observed (Figure 5). Degenerative areas in testis and decreased spermatozoon in

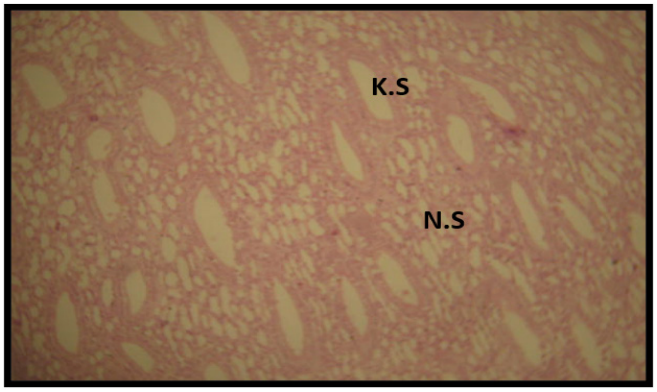

Figure 3 c: Tissue section of l kidney from control rat,(medulla region) contains thick segment of Henle's loop (arrow, KS) with thin segment of Henle's loop (arrow, NS), (H and E, X100).

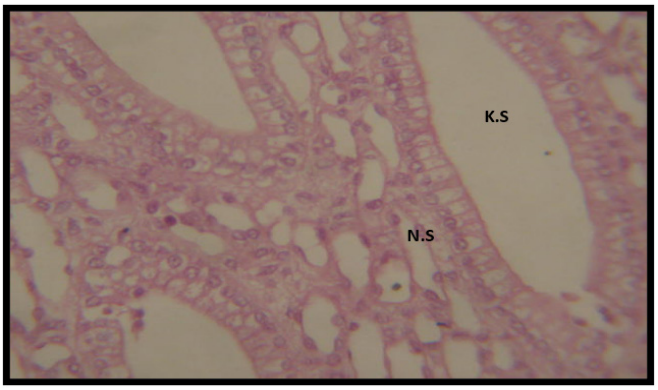

Figure 3 d: Tissue section of l kidney from control rat (medulla region) contain thick segment of Henle's loop (arrow, KS) with thin segment of Henle's loop (arrow, NS), (H and E, X400).

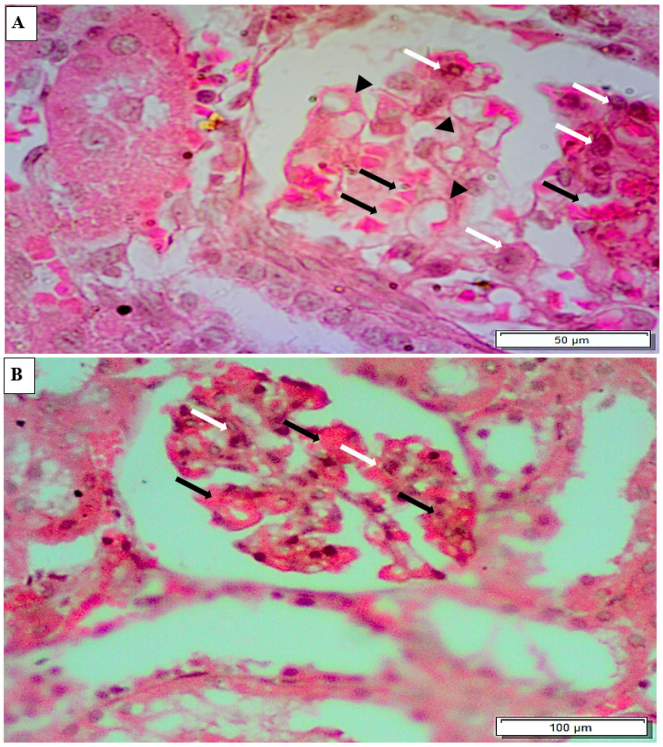

Figure 4 (a and b): Photomicrograph of kidney of Al3 treated rats. H and E, A: X400 and B: X200.

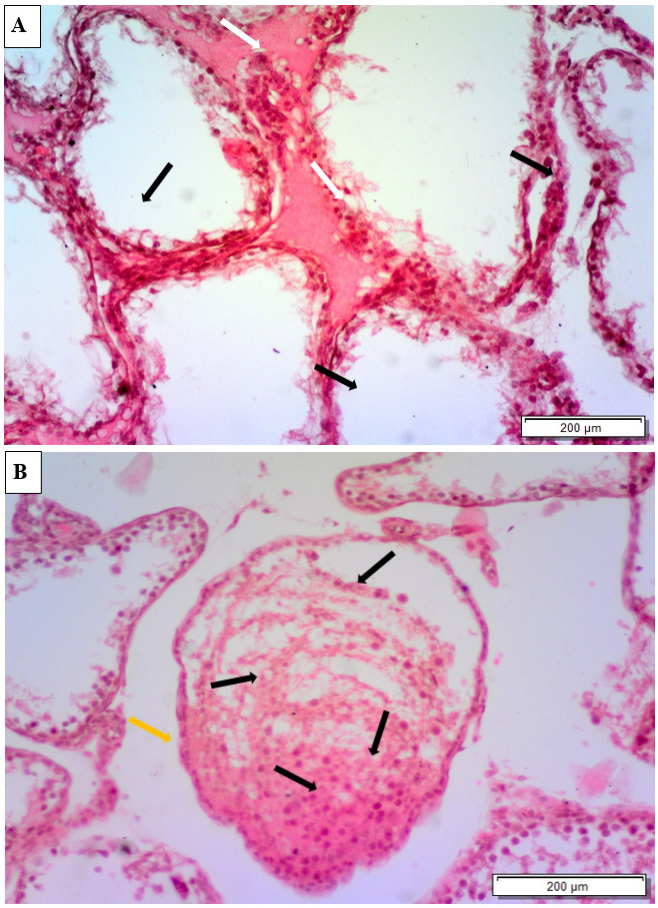

Figure 5 (a and b): Photomicrograph of testes of Al3 treated rats. H and E, A and B: X100.

seminiferous tubules are apparent in subacute poisoning in male rabbits.[11,12]

CONCLUSION

Calcium oxide nanoparticles decreased the number of spermatozoon in seminiferous tubules adult male Wister rats.

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