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Histological Study of Pregnant albino Rat Treated with Nickel Oxide Nanoparticles

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Abstract

The present study was aimed to elucidate the effect of Nickel oxide nanoparticles (100 mg / kg b.wt) on some parameters in pregnant Albino rats,in both period of pregnancy (12 and14 days). 30 albino rats were used; 20 female and the rest 10 were fertilized male rats which were used insemination only, the study including, maternal relative body weight, weight gain measurements and relative organ weights and histological study. Relative body weight of mothers showed decreases in both period of pregnancy**.** Body weight gain of the pregnant rat show decreases in 14 days of pregnancy in treated group as compared with control group while in 12 days of pregnancy showed increases in treated group as compared with control. Relative organ weight showed increases in (Lung, Uterus, kidney) in treated group and decreases in (Heart, Liver, Eye, Spleen, Brian) in (12) day of pregnancy. In (14) day of pregnancy showed decreases in (Heart, Liver, Eye, Brian , Kidney) and increases in (Lung, Spleen, Uterus) in treated group as compared with control group Histological study included some organ (liver, spleen, kidney, lung brain, eye and heart) for different period (12, 14) days of pregnancy.

Key words: *NIO, nanoparticles, albino rats, histology.*

Introduction

Nickel (Ni) is a silvery-white, hard metal. Although it forms compounds in several oxidation states, the divalent ion seems to be the most important for both organic and inorganic substances, but the trivalent form may be generated by redox reactions in the cell [1] . Water-insoluble nickel compounds may dissolve in biological fluids [2] . Particles of the same chemical entity (oxides and sulfides) have different biological activity depending on crystalline structure and surface properties[3, 4]. Inhalation of all types of nickel compounds induces respiratory tract irritation, chemical pneumonia, emphysema and varying degrees of hyperplasia of pulmonary cells, and fibrosis (pneumoconiosis) [6]. Nickel may precipitate autoimmune phenomena and induce immunosuppression in vitro; the clinical importance of such effects has not been reported [7]. The histological changes noted in the lungs of this case included alveolar wall damage with fibrotic changes and oedema in the alveolar space. A statistically significant increase in the incidence of deaths from respiratory disease was found in welders in some studies [8] . Studies in rats and mice demonstrate that chronic active inflammation in the lungs is the most prominent effect following inhalation exposure to nickel sulphate, nickel subsulphide, or nickel oxide [9] In acute exposure, however, chronic lung inflammation wasobserved at the lowest concentrations of nickel sulphate and nickel subsulphide (ATSDR [10] . Chronic exposure for 2 yr to nickel (6 h/day, 5 day/wk) resulted in active lung inflammation in mice at 0.06 mg Ni/m^3 and in rats at 0.11 mg Ni/m^3 and higher. [5]

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Materials and Method

Experimental Design

20 female albino rats were used in this study (in addition to 10 males in this study for mating only). Pregnant albino rats were divided into five groups (n=4), each group was subdivided into control (2) and treated groups(2) Pregnant rats were arranged into groups according to the period of treatment for 12, 14 days of pregnancy.

Rerlative and Body Weight Gain

Weighte of pregnant rats for both control and treated groups for 12 and 14 days of pregnancy were calculated by using electronic sensitive balance in the beginning and the end of experiment to calculate the Relative Body Weight as following:

Relative body weight (%) = final body weight – initial body weight / initial body weight * 100

, while body weights gain of animals was calculated according to the following equation:

Animal weight gain (g) = animal weight - (uterus weight + embryo weight

Organs Weight: the liver, kidney, heart, brain, lung and spleen were removed, cleaned from adherent tissues, drying by filter paper and weighted immediately.

Histological Study: Tissue specimens of liver, kidney, heart brain, lung and spleen were fixed in 10% formalin. Trimming was done on the fixed tissue specimens. Tissue sections was prepared and stained by hematoxylin and eosin stain for histopathological examination by the light microscope.

Statistical Analysis

Results were shown as Mean ± Standard deviation (SE) for each group. Statistical analysis was performed by using SPSS 23. One-way analysis of variance (ANOVA) was used for multiple comparisons. The p≤0.05 was considered to be statistically significant.

Results

Body Weight Gain:

The oral administration of NIOat all treated group (100mg/kg/b.wt) periods showed significant increase (p≤0.05) in relative body weight in comparison with control group for 12days of pregnancy, while it was decreases for 14 days of pregnancy as compared with control group (Figure -1).

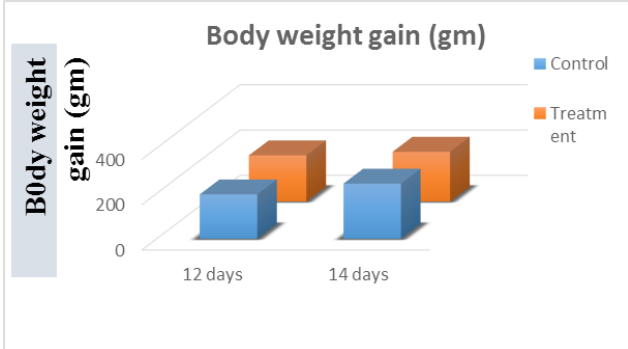

Figure (1): Effect of Nickel Oxide nanoparticles (100 mg/kg b.w.) on Body weight gain (gm) in Pregnant Albino Rats for 12 and 14 days of Pregnancy.

Relative Body Weight.

The result in the present study showed that significant (P≤0.05) decreases in the treated group of (12, 14) days with NIO (100 mg / kg b.wt) in relative weight (12 , 9.26) respectively , as compard with control group (14.56,22) respectively , (Figure 2).

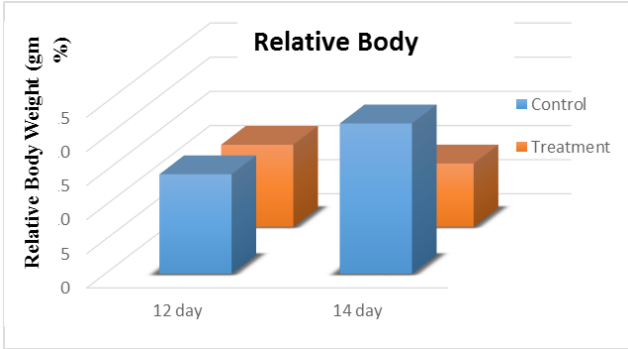

Figure (2):: Effect of Nickel Oxide on Relative Weight of Pregnant Albino Rats for 12 and 14 days of Pregnancy.

Relative Organs Weight

The result of the present study showed that the organ weight means (heart ,liver , eye, spleen , brian) decreases significantly (P≤0.05) in treated group for (12days) withNIO (100 mg / kg b.wt) (0.436±0.05 ,9.36±3.16, 0.173 ±0.064,1.703 ±0.433,1.683 ±0.077) respectively , as compared with control groups (0.473±0.049, 11.16±2.54, 0.313±0.023, 1.896±0.17, 2.74±1.124) and increases significantly (P≤0.05) in weight of (lung , uterus and kidney) in the same treat group (3.16±0.497, 12.99±13.365 , .963±.155) respectively as compared with control group (1.56±0.062, 8.83±0.361, .783±.461) respectively (Table 1).

In the other hand in treated group of (14 day) there were significantly decreases (P≤0.05) of the organs weight

(heart , liver, eye , brain and kidney) (0.376±0.064 , 8.4± 1.93,0.70±0.40, 1.9±0.697, 1.28±0.23) as compared with control group (0.403±0.066,13.93±3.53, 0.466±0.152, 2±0.264 , 1.56±1.28) respectively . and increases significantly(P≤0.05) of the organs (lung , spleen, uterus) in the same treat group (3.066±0.152,1.566±0.635, 14.80±19.40) respectively as compared with control group (1.54±0.096, 0.466±0.152, 7.866±0.503) .

Table (1): Effect of Nickel Oxide on Different Relative Organs Weight (Heart, Lung, Liver, Spleen, Eye, Uterus , Brian and Kidney) in Pregnant Albino Rats for 12and 14 Days of Pregnancy .

Peiods Organs weight	12 day		14 day		Sig. level p≤0.05
	Control (gm) Mean±S.D	Treatmen t(gm) Mean±S.D	Control (gm) Mean±S.D	Treatment (gm) Mean±S.D	
Heart	0.473±0.049a	0.436±0.05a	0.403±0.066a	0.376±0.064a	N.s
Lung	1,56±0.062a	3.16±0.497	1.54±0.096a	3.066±0.152b	S
Liver	11.16±2.54a	9.36±3.16a	13.93±3.53a	8.4±1.93a	N.s
Spleen	1.896±0.17a	1.703±0.433	0.466±0.152a	1.566±0.635a	N.S
Eye	0.313±0.023ab	0.173±0.064	0.466±0.152a	0.70±0.40b	N.s
Uterus	8.83±0.361a	12.99±13.365a	7.866±0.503	24.80±19.40a	S
Brain	2.74±1.124a	1.683±0.077a	2 ±.0.264a	1.9±0.697a	N.s
Kidney	0.783±.461a	0.963±.155a	1.56±1.28a	0.23±1.28 b	S

Histopathological Study for pregnant albino rat

12 days of pregnancy.

Light microscopy micrographs in 12 days of pregnant, the tissue of liver, kidney, brain, Spleen, Eye, Heart and Lung of experimental groups showed regular appearance as in control tissue groups(Fig. 3, 4,5), while the lung section showed abnormality in the treated group with NIO (100 mg / kg b.wt), it showed thick alveolar septæ due to the presence of fibrinous exudate and chronic inflammatory cells as compared with control group.

14 days of pregnancy.

Light microscopy micrographs in 14 days of pregnant, the tissue of liver, kidney, brain, Spleen, Heart and Lung of experimental groups showed regular appearance as in control tissue groups, while the eye section show abnormality in the treated group with NIO (100 mg / kg b.wt), and in the section of Retina with Retinal tissue with atrophy of ganglion cell layer as compared with control group Retina with normal histological appearance during 14 days of pregnancy (Fig.15). Also the lung showed abnormality in the treated group the tissue showed focal areas of moderate chronic inflammatory cell infiltrate of the perivascular areas. as compared with control group.

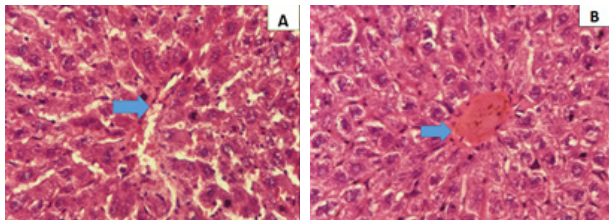

Figure (3) :Cross section in the liver of pregnant rat (12 days) of pregnancy (A) control group , (B) treatment group , Liver tissue showed intact lobular architecture, hepatic plates and sinusoids (H&E x400).

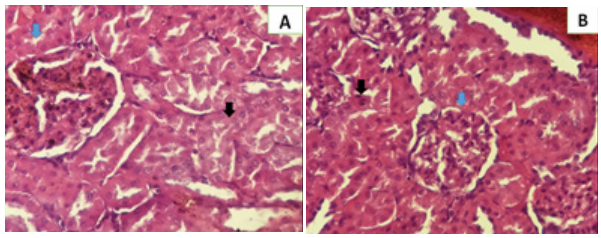

Figure (4): Cross section through pregnant rat kidney at (12 days) of pregnancy, (A) control group , (B) treatment group, Renal tissue with normal glomerulus (blue arrow) and proximal and distal convoluted tubules (black arrow). H&E

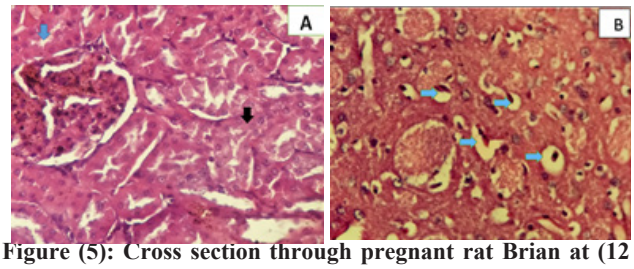

Figure (5): Cross section through pregnant rat Brian at (12 days) of pregnancy (A) control group, (B) treatment group, Brain tissue with normal histological appearance (arrows). H&E. x400.

Discussion

Relative Weight of Pregnant Albino Rats for 12, 14 days of Pregnancy.

The results showed significant (P≤0.05) decreases in the treated group of (12, 14) days withNIO (100mg / kg b.wt) in relative weight, as compared with control group the decreases of the body weight in the curented study is correlated to the toxic effect ofNIO on the female rat and decreases in diet consumption and water in take [12] The weight decrease can be correlated to decrease in diet consumption and water intake [13] The administration ofNIO could be associated with weight loss and several side effects [14] . The weight parameter considered as important indicator for the progress of biological activities and its affected by external effectors. Decrease of body weight may be attributed to anabolic metabolism in body of treated animals, or as a result of anti-digestion effect, or due to the loose of appetite in treated animals as a result of nanoparticles administration [32] . It could also possibly be due to increased degeneration of lipids and proteins leading to decreased organ weight. Other factors may also be responsible for the reduced maternal body weight, may be due to mucophylline-induced resorptions, decreased weight, and growth of the fetus [31] . It is well known that body weight and organ weight coefficients are sensitive indicators of potentially toxic chemicals in general toxicity studies [15] , repeated gavage administration of Ni NPs to rats caused a significant suppression in body weight gain in the male 45 mg/kg group [12]. Other study which indicate the negative effect of Zinc oxide nanoparticles on animal's structure, which represent the vital efficacy of its internal organs .This suggests that exposure to metallic nanoparticles, including silver nanoparticles, could cause gastric intestinal trace GIT disturbances in animals, loss of appetite and decrease fatty tissue in organs, and eventually decrease animal's body weight [16] , The effect of different ZnO-NPs concentrations was obvious on lowering animals' weights, especially with increasing the ZnO-NPs concentration into 200 mg/kg, and duration of exposure from 7 to 14 days [13] . Other study showed different effect of NIO on the kidney which is correlated that the kidney was the major organ of nickel accumulation, and minor renal tubular damage at the corticomedullary junction was observed in rats exposed to NIO for 13 week to a significant decrease in urine volume and urine glucose levels and an increase in relative kidney weight were also observed [17 , 27].

Financial Disclosure: There is no financial disclosure.

Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols were approved under University of Babylon, College of Science, Iraq and all experiments were carried out in accordance with approved guidelines.

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