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EFFECTS OF DIFFERENT DOSES OF ALUMINUM CHLORIDE DISSOLVED IN DEIONIZED WATER MODEL OF WISTAR RATS BLOOD PROFILE 2021-2022 SUDAN

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ABSTRACT

Objective: The study aimed to measure blood profile in Wistar rats treated orally with Aluminum chloride. Experimental design: Fifty rats (average body weight 109 g) were divided into five groups (10 male per group) as follow: Group one (G_1) represented control (without treatment), Group two (G_2) received tap water, Group three (G_3) received 50 mg/kg/day Al Cl_3, Group four (G_4) received 60 mg/kg/day dose of Al $Cl_3$and Group five (G_5) received 70 mg/kg/day dose of Al Cl_3. The treatments were given orally by gavages and continued daily for 60 days. Then blood sample was collected from each rat and measured for blood profile. **Material and Methods:** The techniques were performed according to Automated Haematology Analyser (Sysmex Kx-2IN, Japan, 2009). **Results:** The results for aluminum chloride were indicated that Hb, RBC, PCV, MCV, MCH, WBCs, Lymphocytes and Neutrophils were significant at $p \leq 0.05$ except MCHC and MCV were not significant. **Conclusion:** We conclude that, aluminum chloride decrease red blood cell counts, hemoglobin, hematocrit and increase white blood cell counts, lymphocytes, corpuscular volume, corpuscular haemoglobin concentration.

KEYWORDS: Aluminum chloride, blood profile, wistar rats.

INTRODUCTION

The toxic effects of aluminum are attributed to mediation by reactive oxygen species (ROS) generation giving rise to oxidative deterioration of cellular lipids, proteins and DNA, as well as induction of changes in the activities of tissue antioxidant enzymes, altered gene expression, and apoptosis.[1] The general population is exposed to aluminum primarily through the consumption of food items, although minor exposures may occur through ingestion of aluminum in drinking water and inhalation of ambient air.[2,3,4] Aluminum chloride was said to have negative effects on behavioral endpoints of Wistar rats, it have negative effects on anxiety-related behavior of Wistar rats as it increased the rate of anxiety in aluminum treated rats and effects on the histology of cerebral cortex of adult Wistar rats at higher dose, have detrimental effects on the integrity of the testes of Wistar rats, and also decrease the level of sperm count, but did not result in to infertility.[4] The import of Aluminum on biological systems has been well documented and its involvement in skeletal, hematological, and neurological diseases.[6] Aluminium has been reported to deposit in multiple tissues throughout the body, notably in the kidneys, liver, heart, blood, bones, and brain.[7]

OBJECTIVE

To assess the effect of Aluminum chloride on hematological parameters in Wistar rats.

MATERIAL AND METHODS

Experimental design: Fifty rats were allotted at random to five groups, each of 10 rats. Group 1 received deionized water served as control. Group 2 received tap water, groups 3, 4 and 5 were given Aluminum chloride ($AlCl_3$) respectively 50, 60 and 70 mg/ kg/day via the oral route through cathedral tube. All rats were dosed

their designated experimental oral doses for 8 weeks. Blood samples for hematology after scarifying all animals were immediately collected from each group under mild chloroform.

Hematological methods: These techniques were performed according to Automated Haematology Analyser (Sysmex Kx-2IN, Japan, 2009). This Analyser is an automatic multiparameter blood cell counter for *in vitro* diagnosis use in clinical laboratories. The Sysmex KX-21 process approximately 60 samples per hour and displayed on the LCD screen, the particle distribution curves of WBC, RBC, differential WBC count and platelets count along with data of other parameter.

Blood analysis

Crystal Display Analyzer detection method

Blood sample is aspirated, measured to determine volume, diluted at specified ratio, with transducer use. The analyzer used for detection of the target hematological parameters.

Statistical analysis

All data expressed as descriptive mean, CV, SEM and % were discipline statistic and used to describe and categorize the group of the study, Analysis of Variance (ANOVA) was employed to compare mean concentration of the parameters between groups to compare mean concentration between groups. The data were expressed as, (means ±SD) and significant differences considered with *P* values less than 0.05 and 0.01 all there by SPSS version 16.

RESULTS

The findings represent the haematological parameters for rats given control deionized water (group1), tap water (group 2) and daily oral doses of aluminum chloride (dissolved in deionized water) at 50 mg/kg (group 3), 60 mg/kg (group 4) and 70 mg/kg/day (group 5) during experimental period (8 weeks).

Hemoglobin values in G2 (tap water) were insignificantly, but in G3, G4 and G5 for treated deionized water (G3, G4 and G5) were significant compared with control aluminum chloride (dissolved in deionized water) at $P \leq 0.05$. RBC values were insignificantly difference In G2 and G3, but in G4 and G5 it was significantly low compared with control deionized water at $p \leq 0.05$. PCV values were insignificant in G2 (tap water), but significantly low in G3, G4 and G5 (aluminum chloride (dissolved in deionized water) groups) compared with control deionized water at $p \leq 0.05$. MCV values in all groups were insignificant differences compared with control deionized water at $P \leq 0.05$. MCH values in G2, G3, G4 and G5 were also insignificant differences compared with control rats at $P \leq 0.05$. MCHC values in G2 and G3 were also insignificant differences, but in G3 and G5, it is high significant at $P \leq 0.05$. WBC values were insignificant difference in G3, but it was significantly difference in G2, G4 and G5(aluminum chloride (dissolved in deionized water) compared with control deionized water at $P \leq 0.05$. Lymphocytes value in all groups was significantly high compared with control (deionized water) at $P \leq 0.05$. Neutrophils value in all groups was significantly low compared with control (deionized water) at $P \leq 0.05$.

The results for aluminum chloride were indicated that Hb, RBC, PCV, MCV, MCH, WBCs, Lymphocytes and Neutrophils were significant except MCHC and MCV were not significant.

Table 1: Hematological parameters in rats given aluminum Chloride orally for 8weeks.

Parameters	Groups				
	1.Control (Deionized water) G1	**1-Tap water G2**	**3.Aluminum Chloride (50 mg/kg/day) G3**	**4.Aluminum Chloride (60mg/kg/day G4**	**5.Aluminum Chloride (70mg/kg/day.) G5**
Hb (g/dl)	13.0±0.64	12.6±1.36 NS	10.4±0.87*	9.0±0.63*	7.2±0.75*
RBC ($X10^6mm^3$)	6.8±0.19	6.4±0.28 NS	$5.9±0.22^{NS}$	4.8±0.4*	3.6±0.28*
PCV (%)	37.0±1.09	35.4±1.36 NS	31.2±2.59*	27.0±1.89*	21.6±2.80*
MCV (m^3)	54.0±2.24	54.8±0.75 NS	52.8±2.79 NS	55.8±3.06 NS	60.2±6.36NS
MCH (pg)	17.8±1.77	18.6±1.02 NS	17.0±2.24 NS	18.6±1.04 NS	20.0±2.19 NS
MCHC (%)	33.0±0.0	33.0±0.0 NS	36.2±1.49 NS	37.2±1.49 NS	43.0±2.19*
WBC ($X10^3mm^3$)	3.5±0.1	4.5±0.42*	3.9±0.08 NS	4.3±0.22*	5.4±0.43*
Lymphocytes (%)	35.0±2.0	62.8±2.69*	64.4±1.65*	68.4±1.41*	74.0±3.0*
Neutrophils (%)	65.0±2.0	37.2±3.5*	35.6±1.83*	31.6±1.72*	26.0±3.0*

Values are expressed as mean ± SE; NS = not significant; *Significant = (P< 0.05)

DISCUSSION

For Aluminum salts, following haematological parameters were analyzed after the treatment of various doses of aluminum salts in deionized water (0, 50,60 and 70 mg/kg/day) and tap water. The decrease in PCV and increase in MCV, MCH and MCHC were consistent with changes in red blood cell counts and hemoglobin levels. These changes may be correlated with some pathological changes developed in blood-forming organs, or with the destruction of red blood cells, or with both factors. Naylor (1971) concluded that anemia resulted from hemodilation, extra vascular hemolysis and toxic dyshemopiosis.[6] Majida A.J. al-Qayim and Sawsan Mashi, (2014) reported that aluminum increases the production of free radicals and decreases the erythrocyte ATP concentration resulting in increased membrane fragility and increased RBCs destructions.[8] In previous study, Hisham *et al;* (2012) said that aluminum inhibits heme synthesis, either by inhibition of enzyme activity or interference with iron incorporation or utilization.[9] Struys-Ponsar *et al*; (1994) said that aluminum disorganizes the erythrocyte membrane by altering its mechanical properties, suggesting a reduction of the mean lifespan of circulating erythrocytes, which could play a major role in the anemia.[10] Therefore little concern about toxic consequences of aluminum ingestion because the bioavailability was considered to be poor.[11] In addition the gastrointestinal tract normally represented a barrier to Al absorption under normal circumstances but this barrier can be breached.[12] A significant decrease ($p \leq 0.05$) in haemoglobin, PCV, WBC, and RBC was observed in rats treated with aluminum. Aluminium toxicity induced anemia with Samani *et al; (2015)* who reported a decrease in haemoglobin, red blood cells, as well as the related markers in human in chronic exposure to aluminium.[13] The present research work was confirmed that decreased in haemoglobin. Results obtained from study of hematology indices showed that there was significant ($P \leq 0.05$) differences in the full blood count induced by aluminum. Nasiadek *et al*; (2001) said that aluminum causes anemia by interfering with iron metabolism. The reduced level of hemoglobin content in rats administered aluminum salts can be associated with RBCs hemolysis which confirmed by reduced RBCs count in the present study, or disturbances in heme biosynthesis.[14] Sadhana Shrivastava (2011) said that aluminum interferes with several enzymes taking part in heme biosynthesis pathway including aminolevulinic acid (ALAs) synthetase, δ-aminolevulinic dehydratase (ALA-D), and ferrochelatas, as a result of inhibit linking of iron with heme and drop in activity of these enzymes.[16] Turgut *et al*; (2007) reported that exposure to aluminum salts lead to, decreased Hb, MCV, MCH and PCV, but increase in WHC and Lymphocytes and lowering Neutrophils in rats.[17] Ganchev *et al*; (1998) reported that aluminum also inhibits erythropoiesis and iron metabolism which may hinder haemoglobin synthesis and erythroid cell maturation. Our findings on aluminum salts suggest that causing toxic effect.[18] El-demerdash,(2004) reported that the significant increase in white blood cell levels of aluminum-treated rats might indicate activation of the immune system, a normal cell-mediated immune response. The increase in lymphocytes could be due to the toxic action of the aluminum ion that stimulates the hemopoietic system to release more of these cells, causing an increase in their number in the blood stream.[18]

CONCLUSION

We conclude that, aluminum chloride decrease red blood cell counts, hemoglobin, hematocrit and increase white blood cell counts, lymphocytes, corpuscular volume, corpuscular hemoglobin concentration.

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Recommendations

First, the National Drinking Water Corporation must develop and enhance a system of drinking water purification before entering the distribution system according to WHO standards.

2nd, the Government must prohibit the use of (aluminum chloride (AlCl3) as coagulants in the treatment of water turbidity.

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