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COMPARATIVE STUDY ON EFFECT OF ALUMINIUM CHLORIDE AND ALUMINIUM HYDROXIDE ON SERUM BIOCHEMICAL PARAMETERS IN WISTAR ALBINO RATS

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ABSTRACT

Aluminium is one of the trace elements with a moderate toxic effect on living organisms. This study is to assess the influence of aluminium chloride and aluminium hydroxide intake on biochemical parameters in experimental animals for 21 days. Administration of aluminium chloride and aluminium hydroxide at a dose of 300mg/kg of body weight significantly elevates blood serum urea and creatinine concentration but no change in serum Protein level.

KEYWORDS: **Aluminium chloride, Aluminium hydroxide, Protein, Creatinine, Urea.**

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INTRODUCTION

Aluminium is one of the trace elements with a moderate toxic effect on living organisms.[1] The main sources of aluminium are corn, yellow cheese, salt, herbs, tea leaves, cosmetics, from aluminium ware and containers[2]. Human exposure to aluminium can be from several sources including food, water, pharmaceutical compounds and the environment[3]. Chronic exposure to this trace element can cause alterations in skeletal, nervous, hematopoietic and respiratory systems[4]. Aluminium ions alter properties and structure of cellular membranes, inhibit enzymes like alkaline phosphatase, acetyl cholinesterase and adenyl cyclase[5]. Hence an attempt has been undertaken to assess the effect of short term aluminium intoxication on biochemical parameters in experimental animals.

MATERIALS AND METHODS

The study was conducted at Central Animal House Block, Dr.ALM Post Graduate Institute of Basic Medical Sciences (PGIBMS), University of Madras. The protocol of the study was approved by Ethical Committee. The animals were housed in a large spacious polypropylene cage, bedded with husk and were given food and water. The animal house was ventilated with a 12 hour light/dark cycle, throughout the experimental period. Animal experimentation was conducted according to the current institutional regulations. The animals were maintained on a commercial rat feed manufactured by Pranav Agro Industries Limited, India, under the trade name Amrut rat/mice feed. The feed contains 5% fat, 21% protein, 55% nitrogen free extract, 4% fiber with adequate vitamin and mineral content.

The study comprised 18 male Wistar rats divided into 3 groups of 6. The weight of the rats ranged from 150-210 gms. Numbers were marked on the tail using marker pen for the identification purpose. In our study, rats received 300mg/kg body weight of aluminium chloride and 300mg/kg body weight of aluminium hydroxide orally as per the following table:

EXPERIMENTAL PROTOCOL

Groups	Treatment
Control group	Rats fed with distilled water for a period of 21 days.
I	Rats fed with aluminium chloride orally for a period of 21 days.
II	Rats fed with aluminium hydroxide orally for a period of 21 days.

At the end of experimental period, rat blood was collected from the orbital sinus and serum was separated by centrifugation and used for biochemical estimation. Blood serum creatinine, protein and urea levels were determined by Bonsens et al, Lowry et al and Varley et al methods.

RESULTS

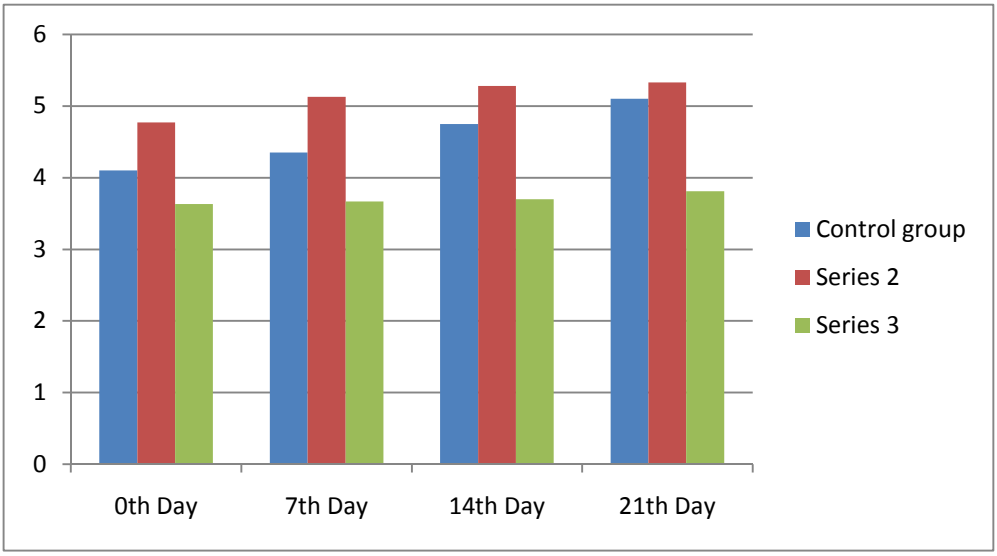
Administration of aluminium chloride and aluminium hydroxide solution for 21 days resulted in statistically significant increase in blood serum creatinine and urea concentration but there was no significant change in serum Protein level. Effects of aluminium chloride and aluminium hydroxide on selected biochemical parameters in rat blood serum are presented in the following tables:

Table 1
Influence of aluminium on serum protein in Wistar Albino rats

Serum protein (g/dL)			
Duration	**Control group**	**Group I**	**Group II**
0th day	4.10 ±0.30	4.77 ± 0.49	3.63 ± 0.36
7th Day	4.35 ±0.43	5.13 ± 0.47	3.67 ± 0.20
14th day	4.75 ±0.46	5.28 ±0.51	3.70 ±0.33
21st day	5.10 ±0. 60	5.33 ± 0.46	3.81 ± 0.38

Group I = $AlCl_3$ Group II = $Al(OH)_3$ n =6 Mean ± SD p*<0.05

Figure 1
Influence of aluminium on serum protein in Wistar Albino rats



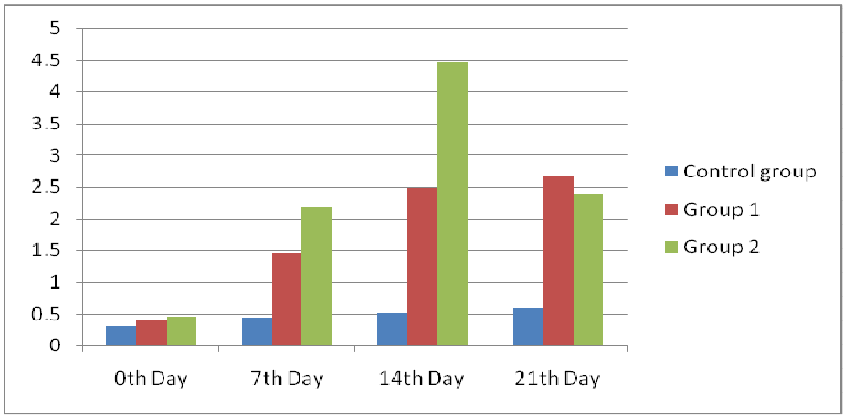
Group I = $AlCl_3$ Group II = $Al(OH)_3$ n = 6 Mean ± SD p*<0.05

Table 2
Influence of aluminium on serum creatinine in Wistar albino rats

Serum Creatinine (mg/dL)			
Duration	**Control Group**	**Group I**	**Group II**
0th day	0.30 ±0.03	0.39 ± 0.03	0.46 ± 0.03
7th Day	0.45 ±0.04	1.46 * ± 0.13	2.19 * ± 0.22
14th day	0.53 ±0.04	2.49 * ± 0.22	4.46 * ± 0.35
21st day	0.58 ±0.05	2.68 * ± 0.25	2.39 * ± 0.21

Group I = $AlCl_3$ Group II = $Al(OH)_3$ n = 6 Mean ± SD p* < 0.05

Figure 2
Influence of aluminium on serum creatinine in Wistar albino rats



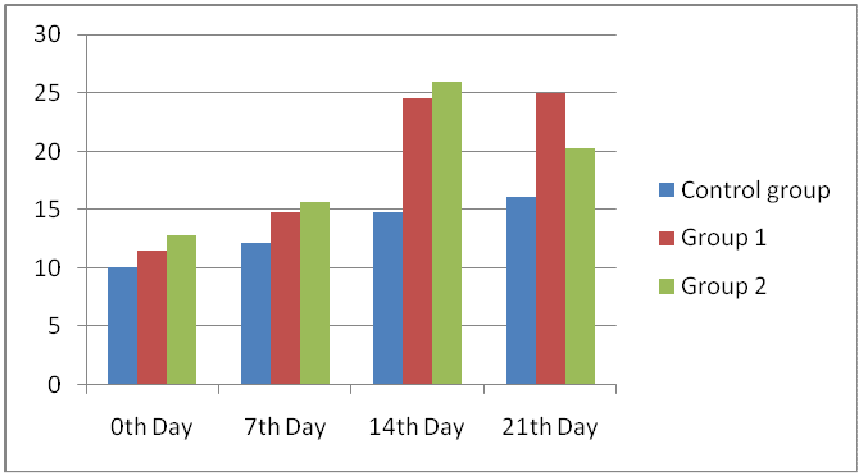
Group I = $AlCl_3$ Group II = $Al(OH)_3$
n =6 Mean ± SD p* < 0.05

Table 3
Influence of aluminium on serum Urea in Wistar Albino rats

Serum Urea (mg/dL)			
Duration	**Control Group**	**Group I**	**Group II**
0^{th} day	10.10 ±1.10	11.45 ± 1.12	12.79 ± 1.29
7^{th} Day	12.12 ±1.10	14.76 ± 1.32	15.70 ± 1.45
14^{th} day	14.80 ±1.03	24.62 * ±2.30	25.99 * ± 2.55
21^{st} day	16.11 ±1.50	24.91* ±2.50	20.27 * ± 2.03

Group I = $AlCl_3$ Group II = $Al(OH)_3$
n=6 Mean ± SD p*<0.05

Figure 3
Influence of aluminium on serum Urea in Wistar Albino rats



Group I = $AlCl_3$ Group II = $Al(OH)_3$
n = 6 Mean ± SD p*<0.05

DISCUSSION

In this study during three weeks observation of rats receiving aluminium chloride and aluminium hydroxide, assessment of harmful effects of aluminium ions was based on the analysis of selected biochemical parameters. It was found that chronic exposure to aluminium ion may lead to mood changes, convulsions, muscular weaknesses, and pathological fractures of bones in humans[4.] Aluminium accumulates mainly in bones, spleen, liver and lungs[6, 7,8]. Entry of aluminium can also occur as a result of medication with drugs containing aluminium as in the case of antacids and vaccines. Kidney can also be one of the targets of toxic impact due to aluminium exposure because kidney may be exposed to high concentrations of aluminium during the normal process of excretion[9]. Aluminium causes damage to kidney cells by loss of cell viability, enzyme release and damage to cell brush borders[10]. Exposure to aluminium also results disruptions in mineral balance disturbances. In the biological systems, aluminium ions replace iron and magnesium ions. They also alter cell membrane structures and activity of many enzymatic processes ,reduce Fe2+ binding to ferritin, and disturb heme synthesis[11].Free iron ions released from biological complexes by aluminium can catalyse hydrogen peroxide decomposition to hydroxyl radical according to Fenton's reaction. The high hydroxyl radical reactivity is able to initiate cellular damage [12, 13, 14, 15, 16]. The study was conducted with selected biochemical parameters to assess the extent of effect and results have yielded valuable information. It was found that blood urea and Creatinine had increased to a considerable level in group I and II where as there was no such change in the control group. The elevation in plasma creatinine and urea levels is considered as a significant marker of renal dysfunction[17]. The renal failure occurs as a result of shrunken glomeruli, intraglomerular congestion, mesangial hyperplasia and obliteration of the filtration slits[18]. Many previous studies have shown that aluminium hydroxide (mainly antacid) has protective effect on progress of renal dysfunction[19]. But this study shows that it also can cause renal toxicity if there is a continuous exposure. Aluminium chloride and aluminium hydroxide do not have an effect on serum protein concentration in any group. Short term exposure to Aluminium does not produce toxic effects in the liver because it is eliminated from hepatocytes into the bile together with lysosomes[20].

CONCLUSION

The results obtained from the present study indicate renal dysfunction as there is a significant increase of serum creatinine and urea concentration in animals that receive these chemicals.

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