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Effect of Aluminium on Testosterone Hormones in Male Rat

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This experiment was performed to study the effect of aluminium on FSH, LH and Testosterone hormones in male rat. The experiment was performed on two groups of male rats; test group received 50 mg kg⁻¹ aluminium chloride (ip) for 20 days. Control group received the same volume phosphate buffer at this period. At the end of experiment, animals were anesthetized with Nesdonal (Sodium thiopental) over dose and sacrificed blood samples were collected and the hormones FSH, LH, Testosterone were measured by RI method. Results showed that LH and Testosterone decreased significantly in the test group compared with that of control group. But the FSH value did not change. These results indicated that aluminium injection in rats could have affect on some of sex hormones. Further studies will probably show the exact mechanism of aluminium ion on these hormones (FSH, LH and Testosterone).

Key words: Aluminium, IP, sex hormone, calcium channels

INTRODUCTION

Aluminium containers are widely used to cook, freeze, or to wrap foods and it is known that aluminium can migrate from containers to the food (Gramiccioni *et al.*, 1996). This ion (Al_3^+) enters the body from many routes such as skin, lung, gastrointestinal tracts and drugs (Liukkonen and Piepponen, 1992; Domingo *et al.*, 1993; Greger and Radzanowsk, 1995). Aluminium can be accumulated in the body tissues (Agarwal *et al.*, 1995). Accumulation is very high in the patients who has anemia (Chang and MacNeil, 1994). Intra peritoneal (ip) administration of aluminium salts in rats, changed creatinine clearance and urine concentration of bivalent ion such as Mg^{++} and Ca^{++} (Yamamoto *et al.*, 1996; Carlos, 1995). Increased serum aluminium causes disorder in enzymes reaction, which has an element in its structures (Liu and Nordberg, 1995). Aluminium poisoning can inhibit signal transduction in cell membrane (Jones and Kochian, 1997). The study shows that aluminium cause anemia (Rosenlof *et al.*, 1990). Aluminium poisoning could affect learning memory and it is an important candid for Alzheimer disease (Koenig and Jope, 1987; Yokel *et al.*, 1994). Aluminium mine workers who have high-level serum aluminium, their TSH and prolactine significantly decreased compared with other workers (Alessio *et al.*, 1989). Renal failure patients with dialysis, have high level serum aluminium, show low reproductive powers than others (Yamamoto *et al.*, 1996). Aluminium is an important calcium channel blocker (Platt and Busselberg, 1994; Busselberg *et al.*, 1994). Voltage gated N, L and T type calcium channels are blocked by Al_3^+ (Busselberg, 1995). The studies show that Al_3^+ disrupts voltage gated Ca^{++} in synaptosomes (Platt and Busselberg, 1994). Zinc (Zn), aluminium(Al), mercury(Hg) and leads (Pb) extracellularly applied, reduced Voltage-activated Calcium Channels Currents(VACCCs) (Platt *et al.*, 1994). Intraperitoneal injection $50\text{ mg kg}^{-1} Al_3^+$ for four weeks showed significantly decreased spermatozoid counts in male mice (Liobet *et al.*, 1994; Domingo *et al.*, 1987). The study showed that calcium ion is important for Gonadotrophine hormones secretion in hypophysis (Mills, 1994; Tse *et al.*, 1993). This experiment was carried out to show the effect of aluminium effects on rat's FSH, LH and Testosterone hormones.

MATERIALS AND METHODS

The experiment was performed on 20 male Sprague-Dawley rats (Razi Institute; Tehran, Iran in 1999-2000), housed in group cages under controlled conditions of (temperature $22-28^\circ\text{C}$ and 12 h, illumination for 20 days

before the experiments). Food and water were continuously available. Rats were weighed by Germany digital BA, 400 S; Sartorius weights (first weight) and randomly divided in two groups (test and control). Test group received 50 mg kg^{-1} body weight of Aluminium Chloride (ip) solution in phosphate buffer for 30 days (Liobet *et al.*, 1994). Ethic code 27-5-1998/1731 School of Medicine, Department of Physiology Ahwaz University, Iran was used. Control group was used at this period received the same volume of phosphate buffer (Placebo). At the end of the experiment time, animals were weighed by the same balance (final weight) and anesthetized with sodium thiopental (Sepia Nesdonal Hungary) and then sacrificed. Blood sampling were collected. FSH, LH and Testosterone were measured by RI method (Alessio *et al.*, 1989). This section of experiment was blind. We could not measure GnRH and blood serum Aluminium. Because serum aluminium decreases Hb and Hct evidently, we measured Hb and Hct. of test and control groups by ordinary Lab. Techniques. Student t- test was used as Statistic-test (Alessio *et al.*, 1989) and results were expressed as $\text{mean}\pm\text{SE}$ and $p<0.05$ that were found to be significantly meaningful.

RESULTS AND DISCUSSION

Results showed that the values of LH and Testosterone in test group were significant (Table 1) when compared with those of control group. But the values of FSH in test and control groups did not show any change. Hemoglobin concentration in test group ($11.31\pm 0.19\text{ g dL}^{-1}$) was significantly decreased compared with that of control group ($13.65\pm 0.25\text{ g dL}^{-1}$). Test group hematocrite concentration ($33.11\pm 0.66\%$) value was significantly decreased compared with that of control group (41.5 ± 1.45) (Table 2).

On the other hand the results of this experiment showed the final mean weight of test group samples ($162.5\pm 18.2\text{ g}^{-1}$) was significantly lower compared with first average weight ($192.6\pm 21.9\text{ g}^{-1}$).

Over observation, this study showed that aluminium chloride injection in rats (test group) decreased LH, testosterone secretion and Hb, Hct and body weight mean values compared with those of control group. The effects of aluminium injection on reproductive system in rat were not investigated but the aluminium effects on mice reproductive system were investigated (Liobet *et al.*, 1994). Al_3^+ and Pb_2^+ administration in ratios synaptosomes culture showed that neurotransmitter release was significantly decreased compared with that of control group (Liu and Nordberg, 1995). Aluminium injection in rat hippocamp showed that, the rate of glutamate

Table 1: Comparison of FSH, LH and testosterone in test (that received aluminium for 20 days) and control groups* = $p < 0.05$, $n = 20$

Group (n)	FSH ($m\mu mL^{-1}$)	LH ($m\mu mL^{-1}$)	Testosterone ($ng mL^{-1}$)
Control (n = 10)	1.96±0.22	2.5±0.7	1.46±0.24
Test (n = 10)	1.65±0.33	1.49±0.24*	0.79±0.2*

Table 2: Comparison of hemoglobin and hematocrite in test group that received aluminium for 20 days with control, * = $p < 0.05$, $n = 20$

Groups (n)	Hemoglobin ($g dL^{-1}$)	Hematocrite (%)
Control (n = 10)	13.65±0.25	41.5±1.45
Test (n = 10)	11.31±0.66	33.11±0.19

neurotransmitter release, significantly decreased compared with that of control group (Chang and MacNeil, 1994). Because calcium ion is important for FSH, LH and Testosterone synthesis and secretion, in this experiment, the effects of aluminium injection (ip), in the animal body increased blood serum aluminium concentration, beyond the blood brain barrier of test group and probably blocked Voltage Sensitive Calcium Channels (VSCC) in cells that are responsible for GnRH synthesis and affecting calcium influx in those cells, and decreased the GnRH secretion (in this study we could not measure the blood GnRH). These causes of phenomenon might have in test group decreased Luteinizing Hormone (LH) in pituitary and eventually led to significantly decreased testosterone when compared with those of control group. On the other hand aluminium may bind relatively strongly to native DNA in cells responsible for GnRH production and alter its functions. In this experiment FSH secretion rate was not affected by aluminium injection may be the FSH synthesis mechanism different from LH and not affected by this ion. On the other hand, Aluminium might have affected on LH secretion (exocytosis) in pituitary and decreased LH secretion and eventually led to decreased Testosterone. On the other hand aluminium might have affected on DNA in Leydig cells and on Testosterone secretion in these animals.

CONCLUSIONS

The results of this study showed that, aluminium injection, in rats affected on LH, testosterone secretion and Hb, Hct and body weight mean values. Further studies will probably show the exact mechanism of aluminium ion on reproductive system.

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