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Impact of Cobalt Chloride on Testis and Male Fertility in Adulthood

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Our work is focused on the impact of cobalt on male fertility. We used two doses of $CoCl_2$ (75 and 125 mg/kg/day) that negatively affected body weight (BW), testis weight (TW) and epididymis weight (EW) in early puberty of male mice. In late puberty restoration of BW, TW but not EW was observed at the two doses of $CoCl_2$ In adulthood treatment with two doses of $CoCl_2$ negatively affects BW. At low dose TW as well as testicular/body weight index was elevated on 45 and 60 pnd. At height dose TW was significantly reduced whereas testicular/body weight index remained unchanged. The number of spermatozoa was lower only in mice treated by high dose $CoCl_2$

Key words: cobalt, male fertility, spermatogenesis.

Introduction

Cobalt is a naturally occurring relative rare element of earth crust. It is an essential oligoelement for mammals and it circulates in human body mainly in the form of vitamin B_{12}. Food and beverages are the main source of cobalt for the general population [6]. The adult human body contains approximately 1 mg of cobalt and human dietary intake of cobalt varies between 5 and 50 mg/day [4]. Cobalt is not a cumulative toxin and is excreted rapidly mainly in urine and to a lesser extent via faeces. Cobalt tends to accumulate in different organs and tissues when the threshold of physiological detoxication is reached and this leads to pathological alterations [3]. People exposed to higher doses of cobalt on occupational settings represent the most influenced group of people to the cobalt action. Degenerative changes in adult seminiferous epithelium involving vacuolation of Sertoli cells and germ cell nuclei were reported by Elbetieha et al. [2]. However, the effect of different doses of cobalt is poorly investigated. In this respect the **aim** of our study was to establish the impact of cobalt chloride applied at low and height doses on testis morphology and fertility of adult mice.

Materials and Methods

Female mice in late gestation were divided into two groups and subjected to two different doses of $CoCl_2$ respectively – low dose (75 mg/kg/day) and high dose (125 mg/kg/day). $CoCl_2$ were applied via drinking water. Male pups were sacrificed on 45 pnd (early maturity) and 60 pnd (maturity). On 25 pnd male mice were separated in individual cages, the $CoCl_2$ doses were calculated and actualized weekly on the base of their own weight. The effect of $CoCl_2$ on testis was evaluated at microscopic level (histological observation) and following quantitative parameters: body weight (BW), testicular weight (TW), epididymal weight (EW), testis/body weight index as well as sperm count. The data obtained were statistically processed using Student's *t*-test.

Results and Discussion

Recently we reported that in early puberty $CoCl_2$ significantly decreased BW at the two doses applied, whereas in mid puberty no negative influence was observed [5]. Current study in adulthood indicated that $CoCl_2$ negatively affected BW in dose dependent manner. In our previous study 20% decrease in TW was found at two doses in early but not in mid puberty [5]. In adulthood $CoCl_2$ negatively and significantly affected TW at high dose only, whereas in low dose $CoCl_2$ even showed slight stimulatory mode of action (Fig. 1). Testicular/body weight index was not changed in early ages [5] whereas in adulthood this index was significantly increased by low dose of $CoCl_2$ that reflects its slightly stimulatory effect on TW. The high dose of Co compound did not produced significant effect on this parameter. Interestingly epididymis during puberty was considered as more sensitive organ to cobalt treatment that the testis [5].

The sperm count was not affected by low dose of $CoCl_2$ on day 45, whereas on day 60 it showed slight stimulatory effect and that correlates with higher TW on this age. The high dose of $CoCl_2$ induced 70% reduction of spermatozoa number by 45-days old

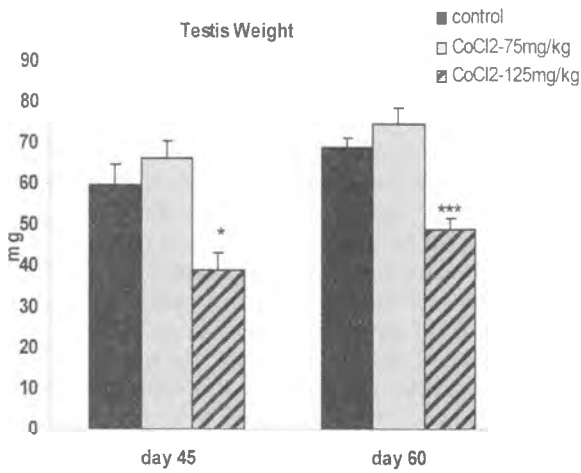

Fig. 1. Testicular weight of control and treated mice with $CoCl_2$ at low (75 mg/kg/day) and high doses (125 mg/kg/day) on 45th and 60th-day. Data represent mean value ± SE (* $p< 0.05$; ** $p< 0.01$; *** $p< 0.001$)

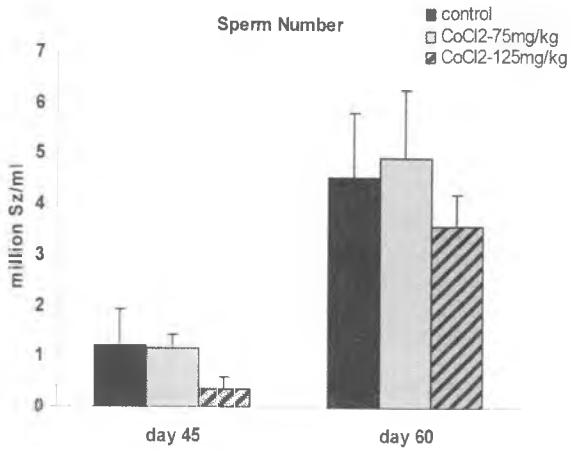

Fig. 2. Sperm number of control and treated mice with $CoCl_2$ at low (75 mg/kg/day) and high doses (125 mg/kg/day) on 45- and 60-day. Data represent mean value ± SE (* $p< 0.05$; ** $p< 0.01$; *** $p< 0.001$)

animals whereas on day 60 the same dose caused 30% decrease of this parameter (Fig. 2). Our data did not show statistical significance which is probably due to high heterogeneity within the treated group.

Histological samples taken from animals in early puberty treated with low dose of the compound showed depletion of germ cells in some seminiferous tubules, whereas other tubules demonstrated normal morphology. In the group treated with high dose it was observed the same type of alterations but the frequency of the affected tubules was higher. On mid puberty as well on maturity (day 45 and 60) we found histological changes only in testes treated by high doses of $CoCl_2$ – germ cell depletion and abnormal formation of tubular lumen (Figs 3, 4). Our findings are in concert with data by Elbetieha et al. [2] about degeneration of seminiferous epithelium.

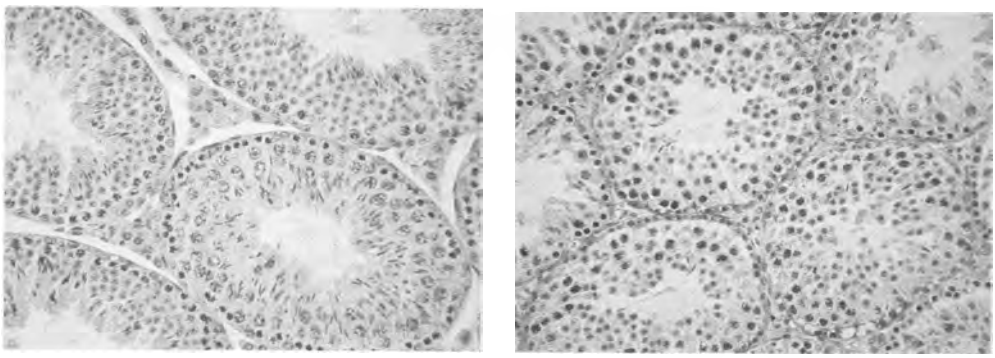

Fig. 3. Testicular cross-sections of control and treated mice with high dose (125 mg/kg/day) on 45 day. × 400

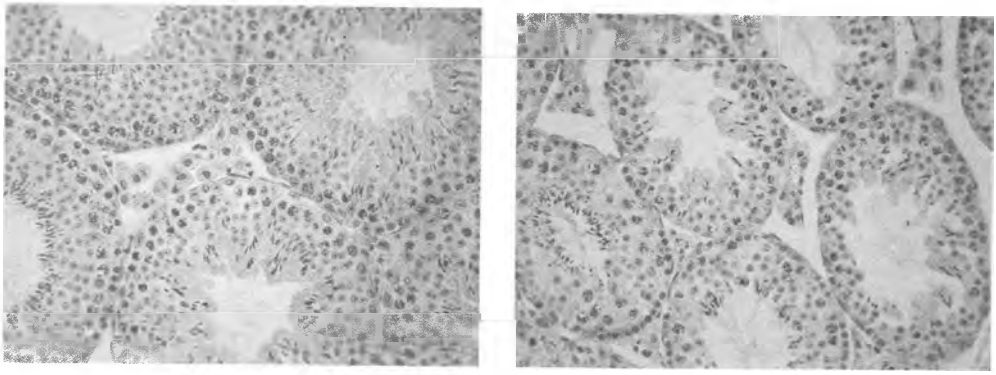

Fig. 4. Testicular cross-sections of control and treated mice with high dose (125 mg/kg/day) on 60 day. × 400

Conclusions

On the basis of our observations as well as data from the literature [1, 2] we could conclude that chronic treatment with cobalt chloride negatively affected male reproductive parameters. Thus its concentrations should be carefully monitored especially on occupational settings with higher quantities in order to protect male reproductive health.

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References

1. Bitner A. M., N.G. Pedigo, R. P. Katz, W. J. George. Histopathology of testes from mice chronically treated with cobalt. – Reproductive Toxicology, **6(1)**, 1992, 41-50.
2. Elbetieha, A., A. S. Al-Thani, R. K. Al-Thani, H. Darmani, W. Owais. Effect of chronic exposure to cobalt chloride on the fertility and testes in mice. – Journal of Applied Biological Sciences, **2 (1)**, 2008, 1-6.
3. Kapadia, C. R. Vitamin B_{12} in health and disease. Part I – Inherited disorders of function, absorption, and transport. – Gastroenterologist, **3(4)**, 1995, 329-344.
4. Lison, D. Cobalt. – In: Handbook on the Toxicology of Metals (Eds. G. F. Nordberg, B. A. Fowler, M. Nordberg and L. T. Friberg) 3rd Edition, 2007, 511-528.
5. Madzharova, M., Gluhcheva, Y., Pavlova, E., Atanassova, N. Effect of cobalt on male organs during puberty. – Biotechnol. Biotechnol. Equip. **24 (2)**, 2010, 321-324.
6. Стоянов, Ст. Тежки метали в околната среда и хранителните продукти. – София, Пенсофт, 1999, с. 288.