DIOXIN IMPACT ON MALE REPRODUCTIVE SYSTEM IN SAMARA REGION OF RUSSIA

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Introduction

By its decision No. 1102 of 5.10.1998 the Government of Russian Federation has adopted the federal program "Protection of Environment and Population from Dioxins and Dioxin-like Toxicants". It stated that one of the global ecological problems of our time is protection of nature and people from the impact of chlorine-substituted dioxins (PCDDs and PCDFs) and dioxin-like compounds. Some regions of Russia are heavily contaminated with these compounds, including Central region, Ural, North-West region. These regions are characterised by highly developed industry, intensive agriculture, and high density of population. Among many other problems, the mentioned program stated the necessity to study the scale and degree of dioxin pollution in districts with chemical industrial enterprises, and to assess the health status of population living in contaminated zones.
One of such big industrial regions is Samara region, which is situated near Volga River. The city of Chapaevsk with population about 90000 situated 40 kilometres from Samara has three chemical enterprises. The biggest of them is Volga Chemical Plant. It had been producing chemical fertilizers, and different chemicals including pentachlorophenol for about 30 years [1]. Production wastes of the plant, containing a wide spectrum of PCDDs and PCDFs contaminated Chapaevsk and the surrounding territories with dioxins. All possible isomers of PCDDs and PCDFs, containing from four up to eight atoms of chlorine were found in the samples of soil, drinking water, vegetables, cow and breast milk.
Frequency of spontaneous abortions in Chapaevsk is higher than in other cities of the province. Babies born to mothers working at the Chemical Plant, display more distinct reproduction pathology (number of premature births, inborn defects) than average in the city. Frequency of infertility in Chapaevsk is 1.5 times higher than in similar non-polluted cities: it is 21% for women and 20% for men.

Materials and Methods

In this study we examined 1500 schoolboys and 51 adult men living in dioxin-polluted city of Chapaevsk and 570 schoolboys and 60 age-matched men from unpolluted areas.
Hormone analysis: LH, FSH, prolactin, testosterone and cortisol were assayed by RIA methods using WHO-matched reagents.

Semen samples were analysed according to WHO criteria. Clinical assessment of male fertility was performed according to the WHO Manual for the Stanadardizied Investigation and Diagnosis of the Infertile Couple (WHO,1993).
Statistical analysis: data are presented as the mean ± SE. Statistical analysis was performed by one-way *ANOVA. Post-hoc multiple comparisons* method was used for detecting significance between group means.

Results and Discussion

We found that among 1500 Chapaevsk schoolboys (age range 10-15 years) the frequency of true cryptorchism is 1.57%, while in the control group it was only 0.8%. Comparison of LH, FSH, testosterone, cortisol, and dehydroepiandrosterone levels in these groups showed no significant differences in hormonal parameters (Table 1).

Table 1. Hormonal parameters in peripheral blood of Chapaevsk schoolboys.

Parameter	Cryptorchism n=30	Controls n=12	*p* - value
Age, years	12.3±0.2	12.7±0.3	0.517
LH IU/L	1.8±0.17	1.5±0.2	0.408
FSH IU/L	1.9±0.3	2.5±0.6	0.332
Testosterone, nmol/L	1.7±0.45	3.0±1.4	0.232
Cortisol, nmol/L	203±18	200±32	0.940
DHEA, nmol/L	7.5±1	8.1±2.0	0.723

Hormonal parameters and spermatogenesis were studied in 51 men (mean age 36±2) living permanently in Chapaevsk, and working at the Chemical Plant. Average duration of their work at the Plant was 10.6±2 years. Control group consisted of 62 men aged 35.4±3.1years living in non-contaminated regions.

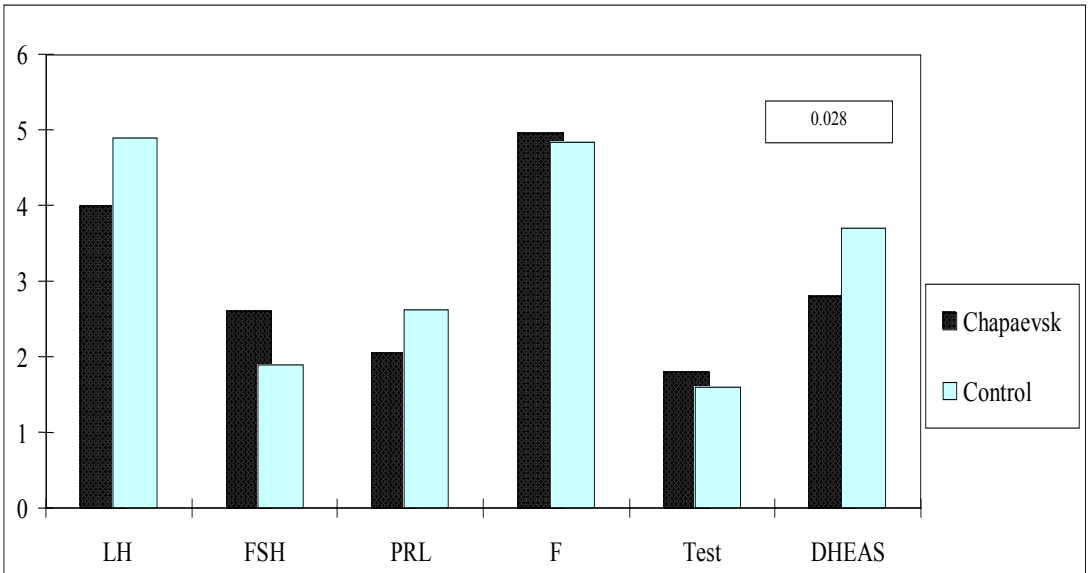

FIG.1. The serum levels of hormones in men
(LH and FSH - IU/L,PRL - mIU/Lx100, F- nmol/lx100, Test - nmol/lx10,
DHEAS - mkmol/l)

Mean levels of LH, FSH, prolactin, and testosterone in both examined groups did not differ significantly, whereas DHEA-S in Chapaevsk men was significantly lower than in controls (Figure1).
Results of semen analysis in Chapaevsk men and in controls are shown in Table 2. All studied sperm parameters (except morphology) between them did not differ significantly. Sperm morphology analysis showed that 92% of men living in Chapaevsk had low percentage of normal spermatozoa forms.

Table 2. Semen analysis in men from Chapaevsk and in controls.

Semen parameters	Chapaevsk	Controls	*p*-value
Volume (ml)	2.6±1.7	3.1±1.3	0.242
pH	7.5±0.3	7.4±3	0.115
Concentration (million/ml)	87±70	71±58	0.344
Motility (% motile)	61±8	64±10	0.428
Vitality (% live)	69±13	64±12	0.786
Morphology (% normal)	17±10	42.8±9	0.000

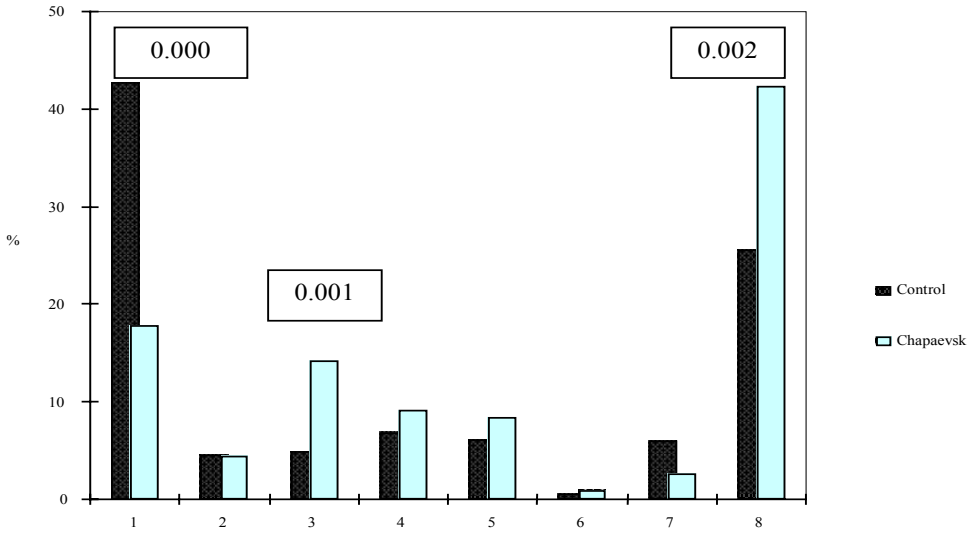

FIG.2. Spermatozoa morphology.

Forms of heads: 1 - normal, 2 - large, 3 - small, 4 - tapering, 5 - pyriform, 6 - double, 7 - vacuolated, 8 - amorphous

Percentage of spermatozoa with small heads and reduced acrosomal regions in Chapaevsk men was 2.5 higher than in controls (Figure 2 and Photo 1).

Besides this we found that Chapaevsk men had higher percentage of spermatozoa with defective midpieces and necks.

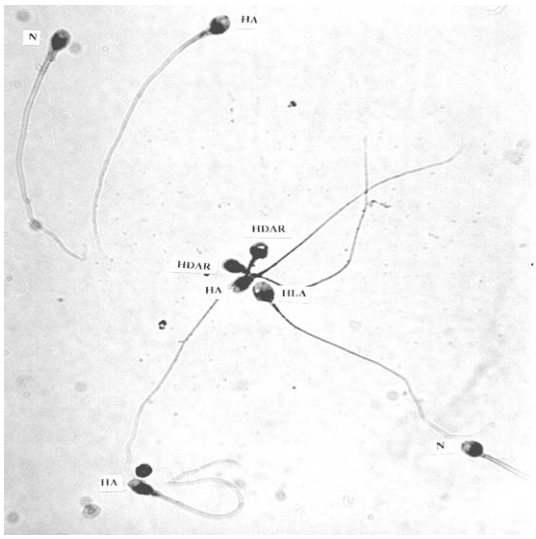

Photo: Sperm morphology in a typical Chapaevsk citizen (N - normal head, HDAR - head with diminished acrosomal region, HA - amorphous head, HLA - amorphous large head)

Our results show that one of impacts of dioxins on male reproductive system results in pathologic spermatozoa morphology (mainly small heads and reduced acrosomal regions) and increased frequency of cryptorchism in boys.

References

1. Levels and profiles of PCDDs and PCDFs in soils and sediments from Chapaevsk, Samara province, Russia. L.A.Fedorov, A.O.Tyler, P.H.Jones, P.M.Vasjuchin. Organohalogen Compounds (Vienna), 1993, v. 12, p.195-198.