Lipid Peroxidation in Various Organs and Tissues of Albino Rats with Cadmium Intoxication in Winter and Summer

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The effect of cadmium chloride on lipid peroxidation in the liver, kidneys, brain, and gonads of outbred albino rats was studied in winter and summer. Cadmium chloride in a daily dose of 2 mg per 100 g body weight was administered intragastrically for 15 days. Administration of cadmium chloride was followed by an increase in peroxide radical production in the liver during the summer period. Lipid peroxidation remained unchanged in the liver, but increased in the ovaries of animals receiving the same dose of cadmium chloride during the winter period.

Key Words: *cadmium; lipid peroxidation; free radicals; albino rats*

Among ecotoxicants, heavy metals occupy a special place, because their content in the environment constantly increases due to the influence of humans on natural ecosystems [4]. Cadmium is a highly toxic metal, which causes various pathological changes in the organism (including activation of lipid peroxidation, LPO) [5,6].

The rate and type of metabolic processes with foreign compounds significantly differ in males and females. Hence, toxicity of many xenobiotics is different for males and females [1,2]. Moreover, the intensity of metabolic transformations strongly depends on the season [3]. These features can determine the toxic effect of substances.

Here we studied sex and seasonal differences in LPO in various organs and tissues under the influence of cadmium chloride.

MATERIALS AND METHODS

Experiments were performed on male and female outbred albino rats (n=48) during the winter and summer periods.

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In each series, the animals were divided into 2 groups: control (intact rats) and experimental. Rats of the experimental group received cadmium chloride intragastrically through a probe in a daily dose of 2 mg per 100 g body weight for 15 days.

The animals were decapitated under chloral hydrate anesthesia (25 mg per 100 g body weight). The organs (liver, kidneys, cerebral hemispheres, and gonads) were isolated. Malonic dialdehyde (MDA) content was measured with TBK-AGAT kits [7].

The results were analyzed by Student's t test (Microsoft Excel software).

RESULTS

LPO in control animals differed in winter and summer (Table 1). During these periods, MDA content in the liver of females was 1.7-fold higher than in males (p<0.01). MDA content in the kidneys of females and males did not differ in the summer period. In winter, the content of thiobarbituric acid-reactive substances (TBA-reactive substances) in the kidneys of females was 1.3 times higher than in males (p<0.05). MDA content in the brain of females and males practically did not differ in summer and winter. Significant sex differences in the

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TABLE 1. Seasonal and Sex Differences in the Content of TBA-Reactive Substances in Tissues (D_{540})

Group		Males		Females	
		summer	winter	summer	winter
Liver					
	control	0.060±0.006	0.100±0.009^{xx}	0.01±0.01^{++}	0.17±0.02^{++xx}
	treatment	0.23±0.06**	0.110±0.008	0.26±0.05**	0.170±0.009
			Kidneys		
	control	0.100±0.008	0.120±0.008	0.090±0.004	0.150±0.003^{+xxx}
	treatment	0.100±0.007	0.110±0.006	0.080±0.003	0.15±0.01
Brain					
	control	0.110±0.009	0.170±0.007^{xxx}	0.100±0.007	0.150±0.009^{xx}
	treatment	0.090±0.019	0.160±0.015	0.100±0.008	0.16±0.01
Gonads					
	control	0.090±0.004	0.110±0.006^{x}	0.060±0.007^{++}	0.070±0.004^{+++}
	treatment	0.080±0.008	0.09±0.01	0.050±0.003	0.090±0.005*

Note. $^{+}p<0.05$, $^{++}p<0.01$, and $^{+++}p<0.001$ compared to males; $^{x}p<0.05$, $^{xx}p<0.01$, and $^{xxx}p<0.001$ compared to summer; $^{*}p<0.05$ and $^{**}p<0.01$ compared to the control.

gonads were revealed in winter and summer. LPO in the testes was 1.5-fold higher than in the ovaries ($p<0.01$).

Comparative study of TBA-reactive substance content in organs and tissues revealed seasonal differences in LPO in various tissues. The content of TBA-reactive substances in the liver and brain was higher in winter than in summer (by 1.7 times in the liver of males and females, $p<0.01$; and by 1.5 times in the brain of males [$p<0.001$] and females [$p<0.01$]). Differences in the content of TBA-reactive substances in the kidneys were particularly pronounced in females. MDA content in the kidneys of females in winter was 1.7-fold higher than in summer ($p<0.001$). MDA content in the testes in winter was 1.2 times higher than in summer ($p<0.05$). Seasonal differences were not revealed in the ovaries.

Administration of cadmium chloride in summer was followed by the increased production of TBA-reactive substances in the liver of males (by 3.6 times, $p<0.05$) and females (by 2.7 times, $p<0.01$). No differences in MDA content in the liver of females and males were revealed during the winter period. Cadmium chloride induced an increase in MDA content in the ovaries, which was particularly pronounced in winter (by 1.3 times, $p<0.05$). Cadmium chloride had little effect on LPO in the kidneys and brain during the winter and summer periods.

MDA content in the majority of organs in control females and males was higher in winter. Sex and seasonal differences were particularly pronounced in the liver, kidneys, and gonads. Cadmium chloride most significantly increased LPO in summer. The toxic effect of cadmium chloride was particularly pronounced in the liver. During intragastric administration of this substance, the blood mainly passes from the intestine to the hepatic portal system. Blood detoxification occurs in this system. The liver was less protected from the toxic effect of cadmium chloride in summer.

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